ENGINEERING NEWS

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The Brooklyn Bridge trustees will receive proposals until May 4 for the construction of the New York terminal station, including structural and architectural steel and ironwork, masonry, carpentry, plumbing and painting. The station will be 580 ft. long and 87 ft. wide, with waiting rooms and ticket offices on the first floor, and the station proper above. There will be two platforms and four tracks. The plans can be seen at the Brooklyn Bridge office, Brooklyn, N. Y.

The use of malleable castings in place of forgings in locomotive construction is being investigated by a committee of the Master Mechanics' Association, of which Mr. R. H. Soule, Superintendent of Motive Power of the Norfolk & Western, is Chairman.

The New York rapid transit proposition of Mr. R. T. Wilson has been withdrawn. Under this proposition the city would have been required to loan its credit to the amount of 70% of the total cost; and this Mr. John M. Bowers, counsel to the Commission, said would be in violation of the state constitution. Mr. Wilson then abandoned his scheme, and the Commission will now proceed, in its leisurely way, in going on with the work of affording immediate relief to the present overcrowded traffic—by extensions of the Manhattan elevated system.

A sanitary survey of Louisville, Ky., has been completed by Mr. Rudolph Hering, at the instance of the Commercial Club of that city. Mr. Hering reported the death-rate as being from 18 to 20 per 1,000, much of which is due to typhoid and other preventable diseases. He recommended the extension of the sewerage system; only one-third of the houses adjacent to present sewers being connected with them. The water supply from the Ohio River is not even suspicious; but the water from wells is condemned. Intercepting sewers and the improved final disposal of the sewage are recommended.

The East Indian Ry. returns for the first half of 1892 show that the operating expenses were 27.60% of the gross receipts, as compared with 26.96% in 1891, while the cost per train-mile was 13.32 cts as against 14.1 cts. The gross receipts were the largest ever recorded. The passenger and freight traffic is steadily increasing. The company manufactures its metal ties (cast iron), splice bars, bolts, and signals (as noted in our issue of April 6), and proposes to establish locomotive works.

A double track is being laid on the Mach-Kolpur section of the Mushkaf-Bolan Railway, India (Eng. News, March 23). This is where the grades are steepest, Kolpur being the station at the northern entrance of the Bolan Pass. By this arrangement all chance of block on these grades will be obviated, the double track being equal to meeting all traffic from the low level section between Sibi and Mach. Another serious landslide occurred between Mud Gorge and Kuch, on the Quetta line, Feb. 28. The line was breached in two places, and a derailment was caused at Puddle Hollow. The slide was a heavy one, extending a mile into the interior. The ground is still slipping, and it is believed that most of the hills in the vicinity of Mud Gorge are again on the move. Traffic is likely to be interrupted. The landslides on the Bolan Ry. were noted in our issue of March 23.

The most serious railway accident of the week was a derailment April 15 on the Cleveland, Lorain & Wheeling R. R., near Medina, O. The engine jumped the track, and, with seven freight cars, went down the bank. One man was killed.

A bridge accident due to a derailment occurred on the Louisville, New Albany & Chicago Ry. at Crawfordsville, Ind., April 12. A north-bound freight train of 35 loaded cars, was approaching the bridge at considerable speed to acquire momentum to climb the grade on the opposite side, when a car was derailed by a broken wheel or axle. The car ran onto the bridge and several other cars were derailed, when the bridge gave way, throwing 13 cars into the river. The accident on the same road, noted in our issue of April 13, is reported as the failure of a temporary structure at a place where a new steel bridge was being erected.

Minor bridge accidents are reported as follows: A trestle near Cypress City, La., on the New Orleans & Northwestern Ry. was burned April 4. About 40 ft. of a trestle on the New Orleans & Northeastern R. R. near Purvis, Miss., was burned April 8. A trestle about 300 ft. long on the Holdrege & Nebraska City line of the Burlington & Missouri River R. R., near Auburn, Neb., was burned April 12. A wooden bridge on the Unadilla River at White's Store, N. Y., was washed away April 4. The covered bridge at Proctorsville, Vt., on the Central Vermont R. R., was burned April 12, involving a loss of $3,000. A highway bridge of two spans over the Sioux River at Akron, Ia., was blown from its piers April 12 by a hurricane, which caused much damage to the city. Several culverts and small bridges on the Louisville, New Albany & Chicago Ry., between Mitchell and New Albany, Ind., are reported to have been washed out.

Hurricanes are reported from several Western states, with much damage and some loss of life. Condray, Mo., was almost destroyed, and at Ypsilanti, Mich., several buildings were wrecked.

Double-end mogul tank engines have been built for the Mersey Railway, running through the Mersey Tunnel between Liverpool (England) and Birkenhead. They have outside cylinders 19½ × 26 ins., with inside valve chambers, necessitating very long ports, as in the Russian engine illustrated in our issue of April 6. There are six driving wheels 4 ft. 7½ ins. in diameter and a single pair of leading and trailing wheels 3 ft. 0½ in. diameter, with radial axles. The smokebox has an extension front. Water is carried in side tanks and coal in a rear bunker. There is no cab, only a vertical "weatherboard" on the boiler head and the coal bunker. Driving wheel base, 11 ft. 6 ins.; total wheel base, 27 ft. 6 ins. The total weight in working order is 151,088 lbs., with 101,920 lbs. on the drivers. The engines are fitted with the vacuum driver and train brake, and steam sand jets to front and rear drivers. The engines were built by Kitson & Co.

Two trains of Allen hotel cars will be run between Providence, R. I., and Chicago, during the summer, exclusively for excursions arranged by W. H. Church. The interior arrangement of staterooms is somewhat similar to that of the Wagner compartment car illustrated in our issue of June 16, 1892, having a "zigzag" gangway, but in the Allen car all the sections are in closed, instead of alternately closed and open as in the Wagner car. The cars are 77 ft. 3 ins. long over platforms, 70 ft. 6 ins. long over the body, 10 ft. 3 ins. wide over all, and 9 ft. 3 ins. wide inside. The sections are 6 ft. 3 ins. long, 2 ft. 6 ins. wide at one end and 5 ft. wide at the other end, and each section, or stateroom, has bath, washing arrangements, gas lights and temperature regulator. There are 18 staterooms, heater, closets, kitchen and pantry. Lockers are provided under the floor. The cars are carried on six-wheel trucks.

The Brown wire-wound gun was tested at Birdsboro, Pa., on April 15. This gun and its manufacture were fully described and illustrated in Engineering News of Nov. 24, 1892. The gun tested had a caliber of 5 ins. and is 19 ft., or about 44 calibers in length. The projectile weighed 60 lbs. and 20 lbs. of powder were used in the first shot; but in the absence of a proper carriage the gun was fired from the flatcar used in transporting it to the proving ground. At the first shot the gage showed a pressure of 25,200 lbs. per sq. in. With 25 lbs. of powder, in the second shot, the pressure was 33,800 lbs., and with the third and final test of 30 lbs. of powder, the car recoiled 15 ft. on the track and the gage, which was set to record a pressure of between 40,000 and 60,000 lbs., was found to have passed beyond the larger figure. The gage was compressed .1656 in., while 60,000 lbs. should have compressed the metal .0841 in. Two gages were used in each test, and the last gages are to be tested at the Frankford Arsenal to estimate the real pressure in the gun, which experts believed exceeded 70,000 lbs. The gun is to be sent to Sandy Hook next week for trial by the government officers. In any event the gun far exceeded in endurance the Army standard of 37,000 lbs.; it was in no way injured.

Elevated railways cannot be built in Philadelphia upon streets occupied by surface road, says Judge Finletter, in passing judgment upon the application to that city of the rapid transit act of 1887. This law plainly says that "all railroads whose route extends through or into any city of the commonwealth may elevate or depress the whole or any part of as much of the line of the railroad as lies within the limits of the city." While this seems plain enough, Judge Finletter rules that this law does not in express terms authorize the construction of elevated roads in the present acceptance of that term. The citizens must again fight the wealthy surface road corporations in the legislature, if they want real rapid transit.

The proposed tunnel under the Hooghly River, at Calcutta, to connect the city and docks with the terminus of the East Indian Ry., at Howrah, on the opposite side of the river, as noted in our issue of April 13, is estimated to cost $2,100,000. On the Calcutta side the approach line is 1,750 ft. long, with a grade of 1.43%, while on the Howrah side the approach is 1,830 ft. long, with a grade of 1%. The length of the tunnel will be about 8,700 ft., with a shaft near each bank of the river. The alinement of the tunnel is mainly on a tangent, crossing the river diagonally, but with 2,709 ft. on a curve of half a mile radius near the Calcutta end. The tunnel would be of iron segments with inside flanges, and a key segment along the roof. The diameter would be 17 ft. in the clear, with a single track of 5 ft. 6 ins. gage. On the Calcutta side the work will be in blue sandy clay and fine sand, while under the river and on the Howrah side it will be mainly in fine sand, touching yellow clay at the lowest point under the river. The work would be done on the Greathead system, and the engineers, Wm. Duff Bruce and J. H. Greathead, have submitted the proposition to the government.

The Manhattan Ry. Co. is not pleased with the terms of the New York Rapid Transit Commission for proposed extensions of the elevated system. Mr. Russell Sage says it would cost $23,000,000 to carry out the plan laid down by the commission, and that the demand of 5% of the company's earnings, after deducting operating expenses, taxes and assessments, is exorbitant. The company would not receive adequate returns on its outlay for at least ten years, says Mr. Sage. He says there is no money in carrying passengers to Yonkers, even at 10-cent fares; but he approves of extending the line to Fort George, at a cost of about $15,000,000, as soon as possible. He does not want four tracks on Ninth Ave. below 59th St., as that line has never made any money and the additional tracks would entail added expense. The company will propose a compromise shortly, and would be willing to divide with the city all profit in excess of 8% dividends on the stock. Another suggestion was that the company be allowed to include interest on the bonded indebtedness before computing net earnings as a basis of division of profits. Mr. Sage said that suburban traffic, or long haul, did not pay, as their present suburban road cost them $240,000 per annum now in excess of receipts.

Asphalt paving in the small streets and alleys of the slums of Philadelphia is being pushed by Director of Public Works Windrim. At present these are badly paved with the old cobble-stone pavement, and Mr. Windrim justly fears that should cholera enter this neighborhood in the coming summer, the inability to keep the street surface clean would much interfere with checking the progress of the scourge. The idea is a good one for all densely populated city areas under such conditions.

The Trenton Falls bridge, of the Adirondack & St. Lawrence R. R., illustrated and described in our issue of April 13, was designed by Mr. Chas. F. Stowell, who also designed the other metal bridges on the line. Mr. Geo. H. Thomson, as the consulting engineer for bridges, was instrumental in the selection of the type of structure and the solid floor design.

NEW TERMINAL STATIONS FOR THE NEW YORK AND BROOKLYN BRIDGE.

We illustrate in the accompanying cuts the general plan and section of the new terminal station to be erected at the Brooklyn end of the New York & Brooklyn Bridge. The plans are in accord with the general design for a tail switching system recommended by the second Board of Experts appointed in May, 1890, whose report was published in our issue of June 17, 1891, although many changes have been made from the board's plans, owing to the necessity of providing for the elevated railways.

The general plan of the station is shown in Fig. 1. As will be seen, it provides for the Brooklyn and Kings County elevated railways, in addition to the bridge railway. It is located on the west side of Washington St., between and over Sands and High Sts. In the plan the main station is rectangular, 355 ft. 10 ins. long and 88 ft. 10 ins. wide, with two opposite projections or wings, each 59 ft. wide. There are three floors; the first, or ground floor, on which are retiring rooms and two ticket booths; the second floor, on which, placed longitudinally, are two passenger platforms and four tracks over the bridge railway; the third floor, on which, placed transversely in each opposite pair of wings, are three passenger platforms and two tracks for the Brooklyn Elevated Ry.; also an intermediate longitudinal gallery connecting these wings. From the third floor a covered gallery runs west to an elevated platform, from which, by stairways, the platforms of the King's County Elevated Ry. station on Fulton St. are reached. Between the first and second floors are two stairways, and between the second and third floors, or between the bridge railway platforms and the Brooklyn Elevated Ry. platforms are nine stairways. At each end of the intermediate longitudinal gallery is a stairway and gallery spanning the two elevated railway tracks and connecting by three stairways with each platform of the elevated railway. From the transverse elevated railway platforms there are also stairways inclosing an elevator and connecting with the bridge footway and the street. The locations of these stairways and the incoming and outgoing passenger platforms for both the bridge railway and the elevated railways are quite clearly shown in the plan. The construction of the station is very simple. The framework will be of vertical columns for the outer walls and intermediate supports, horizontal girders for the second and third floors and trusses for the roofs. All the material will be wrought iron or steel, except the ornamental cast iron work, etc. The outer walls will be of brick and of cast or wrought metal, paneled and shaped and the doors and windows inclosed, and the interior walls and partitions will be of brick or wood and glass. The floors will be of brick or terra cotta, arched between girders and beams and surfaced with concrete or wood. The roofs will be of wood, on iron or steel purlins, covered with sheet iron or slate and glass. The general design of the roof trusses is shown in Fig. 2. They have a span of 88 ft. 10 ins. In addition to the main roof trusses there will be two trusses at each end running diagonally across the intersections of the longitudinal part of the building and the wings, and trusses supporting the ventilator roof. The roof trusses are made up of plates and angles, and the details are generally simple.

The specifications for material require the steel to be of a suitable and uniform quality, known as soft steel, and incapable of tempering. It is required to have an elastic limit of 35,000 lbs. and an ultimate tensile strength of 65,000 lbs. per sq. in. Except for rivets all material shall stretch not less than 20% in 8 ins., with a reduction of the fractured section of not less than 25%, and samples ¾ in. square shall withstand bending cold 180° around a ¾-in. rod, without crack or flaw. In rivets, under tensile strain, it shall stretch not less than 25% in 8 ins., with a reduction of the fractured section not less than 35%, and samples ¾ in. square shall, without crack or flaw, withstand bending cold 180° around a rod ¾ in. diameter and back again. The wrought iron used is to be tough, fibrous and uniform in quality, having an elastic limit of 24,000 to 26,000 lbs. and an ultimate tensile strength of 48,000 to 50,000 lbs. per sq. in. of section, and under tensile strain it shall stretch from 10 to 15% in 8 ins. The higher limits will be required for rods, arch ties, rivets and angle plates made of wrought iron. The specifications for workmanship, etc., do not differ from ordinary good practice in structural ironwork.

The whole building is to be as near absolutely fireproof as possible. As stated before, the spaces between the girders and beams, in the second and third floor systems, except for the galleries and the stairway openings, and in the approach, are filled with arches of brick or terra cotta, so laid as to inclose the arch ties. A bed of calcareous concrete will be laid and finished with a uniform plane surface over the haunches of the floor arches and over the entire area of the first floor, including the sidewalks which surround it. In this, within the walls of the retiring rooms, strips of wood to which the flooring is to be nailed, will be firmly bedded. Upon this bed, exclusive of that within the retiring rooms, will be a covering of fine calcareous or of bituminous concrete finished with a crown on the passenger platforms and with shallow gutters at the margins of the floors.

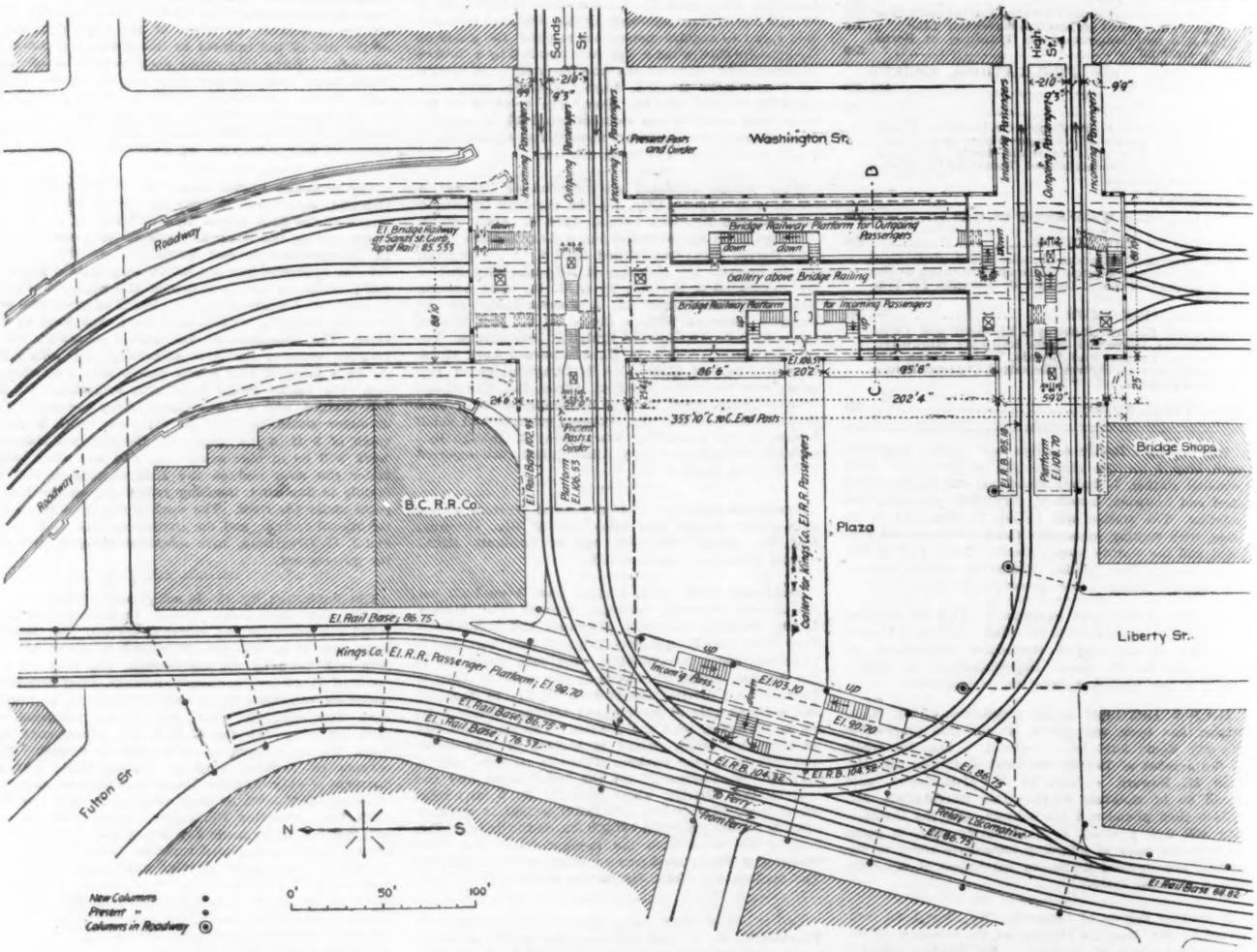

FIG. 1. GENERAL PLAN OF BROOKLYN TERMINAL; NEW YORK AND BROOKLYN BRIDGE.

Wherever required, the otherwise unprotected projecting lower flanges of the girders and beams will be covered with fireproofing or mortar, held in place by wire netting. The main roofs, and, if required, the bracket roofs, will be covered with heavy slates. The outer walls are to be of Philadelphia red brick, and the inner walls, up to the second story, of enameled brick.

The two gantleted tracks will be laid on each line of railway over the bridge, the one leading to the north side and the other to the south side of the incoming and outgoing platforms, respectively, thus avoiding the use of switches by loaded trains. A separate cable, with independent driving plant, will be used for each track of the gantlet; both to be used during busy hours, and one held in reserve for accident at other times. The power house is also to be extended, and an engine of 1,000 HP. by W. Wright & Co., of Newburg, N. Y., will double the present traction capacity.

In addition to the station proper considerable work has been completed, or will be done, on the approaches. As recommended by the board of experts, the storage capacity has been increased by extending the elevated storage yards to Tillary St., as shown in our issue of Jan. 17, 1891. All the land between Sands, Washington, High and Fulton Sts. has been secured and will form an open plaza approaching the bridge entrance.

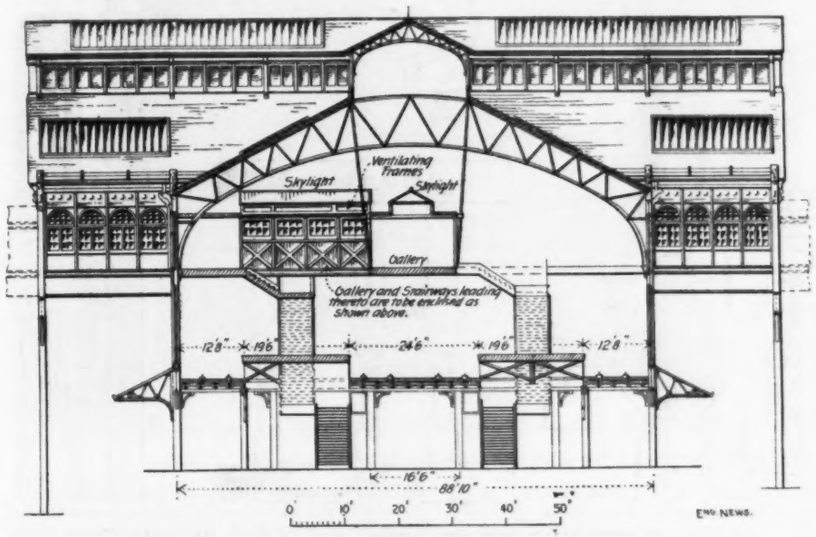

FIG. 2. SECTION AT C. D., SHOWING ROOF TRUSS.

The contractor for the new station is the Phoenix Bridge Co., of Phoenixville, Pa.; A. Bonzano, Chief Engineer. The work was designed and will be carried out under the direction of the New York & Brooklyn Bridge engineering staff; C. C. Martin, Chief Engineer; G. Leverich, Mechanical Engineer. We are indebted to Mr. Leverich for the matter from which our illustrations have been prepared.

Plans have also been adopted by the Bridge trustees for the reconstruction of the New York terminal station, and proposals for this work will be received until May 4. The site includes that of the existing station, and there will be direct connection with the City Hall station of the elevated railway, an elevated passageway across Center St., and stairways to William and Rose Sts. In plan the reconstructed station will be rectangular, 580 ft. long and 87 ft. wide, with a short elevated structure at the southern end, over which the tracks enter the station. There will be two main floors. On the first will be retiring rooms and three ticket booths, and on the second will be two passenger platforms and four tracks. Between these floors, and leading back about 140 ft. from Park Row, will be an intermediate floor, forming a continuation of the elevated passageway across Center St. and Park Row. From the first floor there will be six stairways to the second floor, two ramps and a stairway to the intermediate floor, two stairways (each inclosing an elevator) to the sidewalk at Rose St., and one stairway to the sidewalk at William St.

The structure will be of iron and steel, with brick and architectural ironwork for the outer walls, and brick or terra cotta floors. The girders will be of steel; beams and columns mainly of steel. The roof trusses will be latticed girders, also of steel, and will be 86 ft. 6 ins. span, with ventilation roof trusses of 28 ft. 4 ins. The material is to be mild steel, with an elastic limit of not less than 35,000 lbs. and utimate tensile strength of not less than 65,000 lbs. per sq. in. The elongation is to be 20% in 8 ins., with a reduction of area of not less than 25%. The wrought iron is to have an elastic limit of 24,000 to 26,000 lbs., an ultimate tensile strength of 48,000 to 50,000 lbs., and an elongation of 10 to 15% in 8 ins. The rivets will be of steel.

Each of the two passenger elevators will have two passenger platforms 10×6 ft., with a capacity for 20 persons, or 2,800 lbs., and are to run at high speed.

WORLD'S COLUMBIAN EXPOSITION.—VIII.

Engineering Headquarters.

The reception rooms and office of the general and executive committees of the Associated Engineering Societies of the United States and Canada and of the general committee of the World's Congress Auxiliary on the International Engineering Congress, will be at 10 Van Buren St., Chicago, Ill., from May 1 until the close of the Exposition. All communications after May 1 should be addressed to, or in care of, Mr. Max E. Schmidt, Secretary. Visiting engineers may have their mail thus addressed. The committee rooms of the Associated Engineering Societies at the Exposition will be situated in the southwest corner of the gallery of the Mines and Mining Building, where the secretary or some of the staff will be present during the Exposition to meet visiting engineers. Mr. E. L. Corthell is Chairman of the Executive Committee.

International Engineering Congress.

The affairs of the Engineering Congress are intrusted to a general committee, assisted by an advisory council. The general committee will have direct control of the organization and proceedings of the general sessions of the congress. It will determine the general programme of proceedings and the times and places of the divisional sessions. The following is an abstract of the several programs:

All formal invitations to participate in the congress will be issued by the general committee. In order that a complete list thereof may be in its possession, the representatives of the several divisions will transmit to the general committee from time to time the names of such additional persons or societies as they may desire to have invited, and such persons or societies will be at once formally invited. Such invitations will entitle the recipients to free participation in the proceedings of all sessions without assignment or special relation, however, to any one division.

In order to prevent any possible misunderstanding through accident or clerical error, it is announced that all individuals or delegates who have been invited by the representative of any division, but, for any reason, have not received the official invitation of the general committee, will be entitled to receive such invitation at any time.

Communications upon subjects in direct charge of the general committee, should be addressed to Mr. E. L. Corthell, Chairman, Room 902, "The Temple," Chicago.

The congress is to comprise seven divisions, as follows: Division A. Civil Engineering, in charge of the American Society of Civil Engineers. Address F. Collingwood, Secretary, 127 East Twenty-third St., New York, N. Y.—Division B. Mechanical Engineering, in charge of the American Society of Mechanical Engineers. Address F. R. Hutton, Secretary, 12 West Thirty-first St., New York, N. Y.—Division C. Mining Engineering, in charge of the American Institute of Mining Engineers. Address R. W. Raymond, Secretary, 13 Burling Slip, New York, N. Y.—Division D. Metallurgical Engineering, in charge of the American Institute of Mining Engineers. Address R. W. Raymond, Secretary, 13 Burling Slip, New York, N. Y.—Division E. Engineering Education, in charge of a special committee. Address Prof. I. O. Baker, Chairman, University of Illinois, Champaign, Ill.—Division F. Military Engineering, in charge of Maj. Clifton Comly, U. S. A., representing the U. S. War Department at the Exposition. Address Maj. Clifton Comly, Governor's Island, New York Harbor, N. Y.—Division G. Marine and Naval Engineering, in charge of Com. George W. Melville, Engineer in Chief, U. S. Navy. Address Com. Geo. W. Melville, Eng. in Chief, U. S. N., Washington, D. C.

The divisional sessions will be organized and controlled by the officers in charge of the divisions. There may be joint sessions of two or more divisions, which will be similarly controlled by the divisions concerned. Correspondence concerning the papers and proceedings of any division should be addressed to the representative thereof, and not to the general committee.

The time assigned to the Engineering Congress is the week beginning Monday, July 31, and ending Saturday, Aug. 5. There will be an opening general session at 10 a. m., July 31, in one of the large halls of the Art Palace, in the Lake Front Park, in Chicago. This is in the business or down-town part of the city and not at the Exposition grounds. After appropriate addresses the divisions will be convened in their respective session rooms in the same building.

Cards of admission to the congress will be issued by the secretary of the general committee, upon presentation of introductory cards given by the officers in charge of the several divisions, or by the officers of the societies invited to participate in the congress. The cards of admission will entitle the holder to attend the meetings of any of the sessions. There will be no entrance fee for participation in the proceedings.

The proceedings will consist of the reading and discussion of such papers as shall have been accepted by the management of each division, and according to the rules which may be adopted. It is expected that a number of these papers will be secured and printed beforehand, so that copies can be obtained (but not for publication) by those desiring to offer contributions to the discussions. In general, the papers will not be read at length in the congress, but will be printed in advance and presented in brief abstract, so that the discussion may proceed with as little loss of time as possible. As a general rule, precedence will be given to those who shall have sent in discussions in writing, and subsequently to those who shall have given notice of their desire to be heard.

Papers to be presented will, for the most part, be secured by direct invitation, but offers of papers are welcome at any time, subject, however, to acceptance by the officers in charge of the divisions to which such papers may belong. Preference will be given to papers which relate to new and important constructions, machines, processes, methods, experiments and investigations. Opportunities will be given for the display of wall diagrams and stereopticon (magic lantern) views in illustration of papers.

It is intended that all papers printed by the divisions shall be in English. Papers may be offered in French, Spanish, German and other languages, and, if accepted, will be translated and printed in English. Discussions may be in any one of the three languages mentioned, and interpreters will be provided whenever necessary.

A daily programme will be issued each morning by the general committee stating the order of papers and proceedings, so that engineers in attendance may select the sessions at which they prefer to be present. This programme will indicate the rules to be followed, and as far as practicable the speakers who are to take part in the discussions. There will be five morning sessions of the divisions, some of which may be joint

sessions, and the congress will terminate with a general morning session on Aug. 5, on which day there will be no divisional sessions. The afternoons may be devoted to further sittings, or to visits to the Exposition or other points of engineering interest, as may be determined by the divisions. It is expected that the evenings will be given up to receptions and social intercourse.

It is contemplated to publish the entire proceedings of the Engineering Congress, and to sell copies at cost to engineers who may subscribe for the same, but the societies having in charge the management of divisions will have the right of publishing appropriate portions of the proceedings of their divisions. After the close of the congress, it is intended to arrange for excursions to points of engineering interest, particulars of which will be announced later. Arrangements are in progress for securing the lowest practicable rates of transportation for those attending the congress. E. L Corthell, Chairman; D. J. Whittemore, Vice-Chairman.

World's Congress Auxiliary.

The general particulars of the organization of this branch of the Exposition were given in our issue of Jan. 5. The Auxiliary is constituted as follows: 1, Central organization, authorized by the Directory of the World's Columbian Exposition, and recognized by the government of the United States as the proper agency to conduct a series of World's Congresses in connection with the Exposition; 2, A local committee of arrangements for each congress; 3, Advisory councils composed of persons eminent in the work involved, and selected from many parts of the world; the members of such councils co-operate with the proper committees by individual correspondence; 4, General honorary and corresponding members, who are invited to give their advice and co-operation in relation to the whole series of proposed congresses; 5, Committees of co-operation, appointed by particular organizations as representatives of societies or institutions; and, 6, The woman's branch. Mr. C. C. Bonney is President; Treasurer, Lyman J. Gage; Secretary, B. Butterworth.

The general objects of the World's Congress Auxiliary are to provide for the proper presentation of the intellectual and moral progress of the world in a series of congresses, to provide places of meeting and other facilities for these congresses in Chicago, at a convenient time during the Exposition season of 1893, for the consideration of the questions pending in the various departments; and also to provide for the proper publication of the proceedings of such congresses.

There will be 19 departments; and the following list indicates the progress made by the Auxiliary to September, 1892. In each department a preliminary organization has been effected, and a preliminary publication issued. That publication sets forth the scope of the department, the nature of the subjects to be considered, the division of the department and its committees, and the advisory councils so far as appointed. Most of the committees have issued a preliminary address, inviting suggestions of themes to be considered, persons to present them, and the best methods of proceeding. Several of the departments include subjects of interest to engineers. The arrangements of the congresses, abstracted from the official program, are as follows:

1, Department of Woman's Progress.—This includes all the fields in which women have achieved success, and will commence May 15.

2, Department of the Public Press.—The daily press, weeklies and magazines, the religious press, trade journals, scientific and professional journals, etc., will be represented. The congresses of this department will be held during the week commencing May 22.

3, Department of Medicine.—The congresses of the general division of medicine and surgery will be held during the week commencing May 29, and the congresses of dentistry, pharmacy and medical jurisprudence, during the week commencing Aug. 14. Public Health will precede the Agricultural congresses, in October, and has been given a separate department, on account of its inter-state and international relations, and deferred to that late date because the public health officers cannot well leave their posts of duty during the summer.

4, Department of Temperance.—The congresses of this department will be held during the week commencing June 5.

5, Department of Moral and Social Reform.—This includes the public treatment of pauperism; the care and treatment of juvenile delinquents; the hospital care of the sick, the training of nurses, dispensary work, and first aid to the injured; the care and treatment of the insane, the prevention and repression of crime, and the punishment and reformation of criminals, etc. The congresses will begin June 8, and continue during the following week.

6, Department of Commerce and Finance.—This includes the general divisions of banking and finance, boards of trade, stocks and bonds, water commerce, railway commerce, commercial clubs, insurance, building associations, mercantile business, etc. The congresses will commence June 19. The Water Commerce Congress will be transferred to the first week of August, in order that it may be held with the Engineering Congress.

7, Department of Music.—The congresses will be held during the week commencing July 3. The congress of the general division of public instruction in music will be transferred from the Department of Education to the Department of Music.

8, Department of Literature.—This includes the general divisions of libraries, history, philology, authors, folk-lore and copyright. The congresses will commence July 10.

9, Department of Education.—This includes university extension, public instruction, manual and art training, business and commercial education, education in civil law and government, college and university students, college fraternities, physical culture, domestic and economic education, etc. The general division of

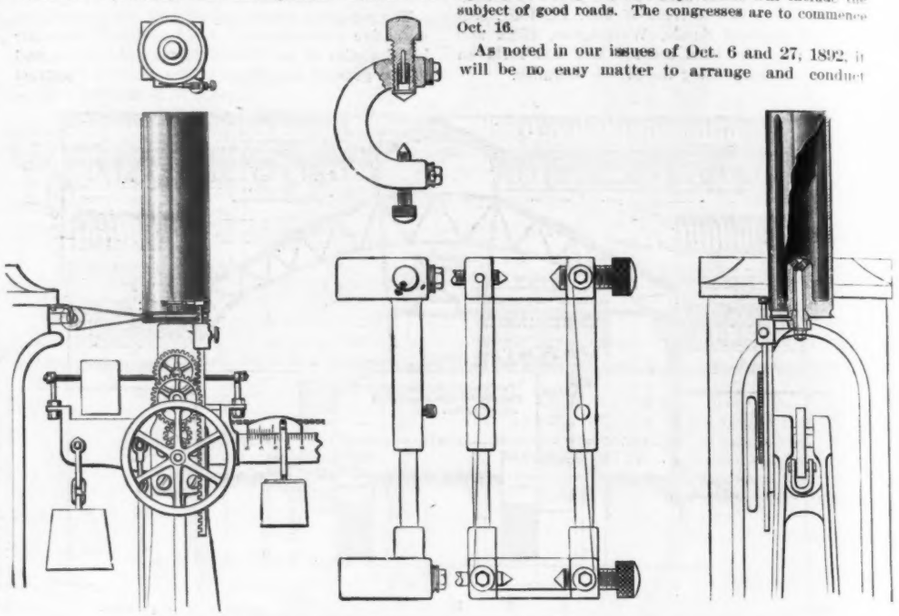

FIG. 1. AUTOMATIC CARD ATTACHMENT FOR TESTING MACHINES.

public instruction in music has been transferred to the Department of Musical Art. The congresses will commence July 17, and will be followed by the World's General Educational Congress, in which all the departments of education will be properly represented.

10, Department of Engineering.—This includes the general divisions of civil, mechanical, mining, metallurgical, electrical, military, marine and naval engineering; aerial navigation and engineering education. The congresses of this department, and the Water Commerce Congress will be held during the week commencing July 31.

11, Department of Art.—This includes architecture, painting, sculpture, decorative and photographic art, government patronage of art, art museums, art education, etc. The congresses will be held at the same time with those of the department of engineering, commencing July 31, the places of meeting being adequate as mentioned below.

12, Department of Government.—This includes jurisprudence and law reform, political and economic reform, city government, executive administration, intellectual property, arbitration and peace. The congresses will commence Aug. 7, and may extend into the following week. The Economic Congress will be deferred till the week commencing Aug. 28, in order to be held at the same time with the Labor Congress.

13, General Department of Subjects Specially Assigned.—This will include congresses not properly belonging to any other department; and also congresses which for any special cause could not be held in their appropriate places in the other departments, among which will be a congress on the African continent and people. These congresses will commence on Aug. 14.

14, Department of Science and Philosophy.—This includes physics, astronomy and mathematics, meteorology, geology, geography, chemistry, electricity, botany, zoology, microscopy, ethnology and archaeology, psychical science, philosophy. The congresses are assigned to the week commencing Aug. 21.

15, Department of Labor.—This includes the historic development of labor, labor organizations, conflicts of labor and capital, labor economics and legislation, domestic economy, etc. The congresses will be held in the last days of August and the first days of September, closing on "Labor Day," Monday, Sept. 4.

16, Department of Religion.—The world's parliament of religions, Sept. 11. The denominational congresses Sept. 21. The missionary congresses Sept. 28; the congresses of other bodies will follow.

17, Department of Sunday Rest.—This includes the economic, business, governmental and political relations, the social and moral relations, and the religious relations of the weekly rest day. These congresses will be held in October, immediately after those of the religious societies above named.

18, Department of Public Health.—This includes sanitary legislation, public health authorities, governmental administration in relation to epidemics and contagions, food inspection and other food problems. The congresses will follow that of the Department of Sunday Rest, in October, the exact date being announced later.

19 Department of Agriculture.—Besides the ordinary agricultural subjects, this department will include the subject of good roads. The congresses are to commence Oct. 16.

As noted in our issues of Oct. 6 and 27, 1892, it will be no easy matter to arrange and conduct these congresses, but the following is an abstract of the statements in the official program on this point:

To make the proceedings of the various congresses as valuable as possible, to reduce as far as practicable the expense of such publication, to prevent repetitions of matter and duplicate assignments of speakers, to secure such a strength and force of treatment as will insure the widest reading, to guard against encroachments by one speaker on the time which justly belongs to another, and to secure a just representation of all the participating countries, the themes to be presented in the various congresses will be selected with a view to make a complete and orderly treatment of the general subject embraced in the department. The programs of the different departments and divisions will be carefully compared; and all papers and remarks will be strictly limited to an allotted time. It will obviously be better, in a given hour, to have two or three compact papers from as many different leaders, than to give the time at command to one of them for a long discourse, embracing several subjects. The object will be to state results and present existing problems, and for this purpose lengthy papers are neither necessary nor desirable.

Unprepared discussion or miscellaneous debate would obviously be inconsistent with a plan of which the chief object is to procure the maturest thought of the world on all the great questions of the age, in a form best adapted to universal publication. The time at disposal after the delivery of a discourse will, therefore, be given to the most eminent persons present, who will speak on the call of the presiding officer, and to whom such previous notice as may be practicable will be given.

The executive administration of each congress will

necessarily be in charge of the committee of arrangements, and the officers of the Auxiliary, who alone can be familiar with all the details involved. But the plans of the Auxiliary have provided that the largest practicable number of persons eminent in the work involved in a given congress shall be asked to act as presiding officers..

The government of the United States, recognizing the World's Congress Auxiliary as the proper agency to conduct these congresses, has directed the diplomatic and consular officers of the United States in all countries to request "that a convenient number of the most eminent representatives of the various departments of human progress be selected as delegates to attend the respective congresses, by or under the direction of the government to which they are respectively accredited, in addition to those who will come as the representatives of the leading institutions and societies of different countries; and to extend the assurance that the largest practicable participation of foreign peoples and governments in the whole series of the congresses is especially desired."

The congresses will be held in the permanent Memorial Art Palace, erected on the Lake Front Park, through the co-operation of the Art Institute, of Chicago, the city of Chicago, and the directory of the Exposition. This will have two large audience rooms arranged to seat about 3,000 persons each; and more than 20 smaller rooms, which will accommodate from 300 to 700 persons each. Meetings of such a character as to draw a large, popular audience will be held in the main audience rooms, while meetings of chapters or sections of different congresses for the discussion of subjects of a more limited interest, will be held in the smaller rooms. It will thus be possible to have two general congresses and 20 special congresses or conferences in session at the same time, and to have three times as many meetings within a single day by arranging different programs for morning, afternoon, and evening sessions; but it is not anticipated that so many daily meetings will be required in any department, or, that, as a general rule, any congress or section will desire to meet more than once or twice in a given day.

Organization of the Exposition.

For convenience of reference it may be appropriate to explain here that the World's Columbian Exposition is a corporation organized under the laws of the state of Illinois, for the management of the Exposition of 1893. This corporation has also been approved by the government of the United States for that purpose. The World's Columbian Commission consists of two commissioners from each state and territory of the United States and the District of Columbia, with eight Commissioners-at-Large, appointed by the President of the United States, to co-operate with the directory of the Exposition in the work involved. The Board of Lady Managers of the World's Columbian Commission is composed of ladies appointed under the act of Congress, to represent the special interests of women. Mr. Harlow N. Higinbotham is President of the Exposition.

Public Convenience.

In view of various inquiries sent to the management, the president of the Exposition, Mr. H. N. Higinbotham, has issued a circular giving the following information: 1. The Exposition will be opened in readiness for visitors May 1. 2. An abundance of drinking water, the best supplied to any great city in the world, will be provided free to all. The report that a charge would be made for drinking water probably arose from the fact that hygeia water can also be had by those who may desire it at 1 ct. a glass. 3. Ample provisions for seating will be made without charge. 4. About 1,500 toilet rooms and closets will be located at convenient points in the buildings and about the grounds, and will be free to the public. This is as large a number in proportion to the estimated attendance as has ever been provided in any exposition. In addition to these there will also be nearly an equal number of lavatories and toilet rooms of a costly and handsome character as exhibits, for the use of which a charge of 5 cts. will be made. 5. The admission fee of 50 cts. will entitle the visitor to see and enter all the Exposition buildings, inspect the exhibits, and, in short, to see everything within the Exposition grounds, except the Esquimau village and the reproduction of the Colorado cliff dwellings. For these as well as for the special attractions on Midway Plaisance a small fee will be charged. 6. Imposition or extortion of any description will not be tolerated. 7. Free medical and emergency hospital service is provided on the grounds by the Exposition management. 8. The Bureau of Public Comfort will provide commodious free waiting rooms, including spacious women's parlor and toilet rooms, in various parts of the grounds.

The "universal scale," noticed in our issue of March 30, is now in the hands of the Universal Scale Co., of 310 W. 103d St., New York city. Those interested will please address the company, to which Mr. Yelden has assigned his rights in the device.

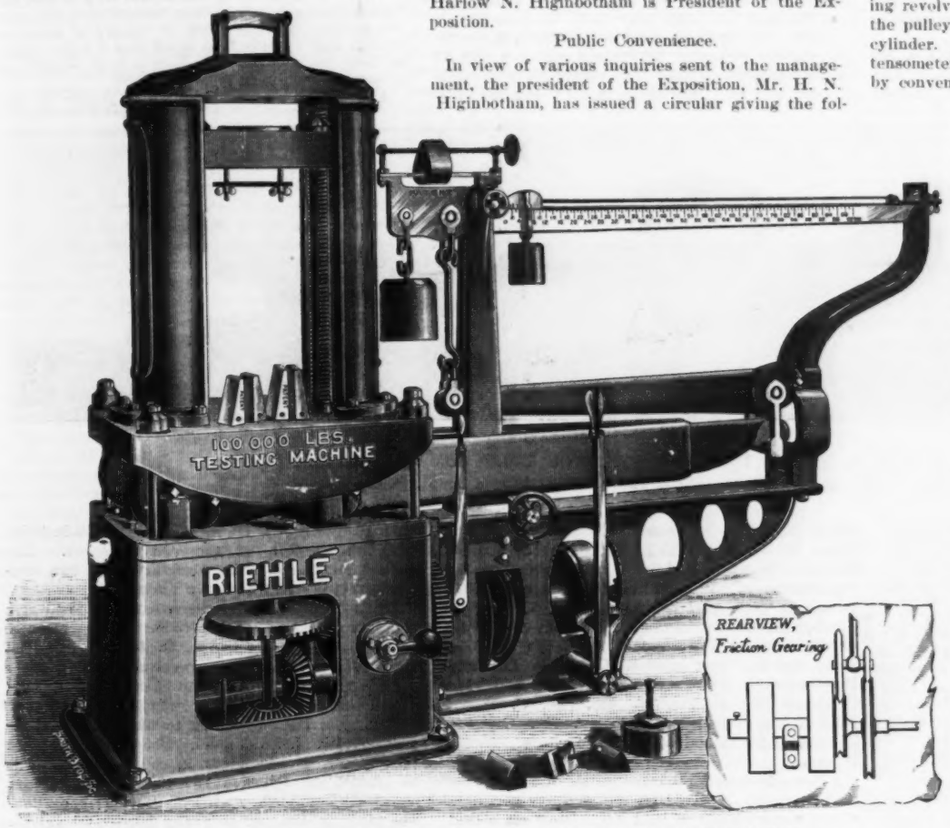

FIG. 2. TESTING MACHINE FITTED WITH AUTOMATIC CARD ATTACHMENT.

AUTOMATIC CARD ATTACHMENT FOR TESTING MACHINES.

An apparatus for tracing a diagram of the test curve is an important addition to a testing machine, and the accompanying cut represents a simple apparatus manufactured for this purpose at the works of the Riehle Bros. Testing Machine Co., at Philadelphia, Pa.

The apparatus, shown in Fig. 1, consists of a cylinder mounted on a bracket and capable of being revolved easily by a tape or wire attached to the pulley, which is a part of the bottom of this cylinder. The wire connects with a telescopic extensometer, which is fastened to the test specimen by convenient screws, one of which, in each pair, has a spring to follow up reduction of area in the specimen. The elongation of the specimen takes up the connecting wire at each side, thus doubling the actual stretch, and any further multiplication can be given by means of an intermediate drum with different sizes of steps for the purpose. This elongation of the specimen causes the drum to revolve on its axis, while the vertical ordinants of pressure are obtained by means of a rack and gears operated from the hand-wheel, which causes the poise to travel, and any convenient reduction of this travel can be made to suit the nature of the specimen or pleasure of the observer.

To the left of the illustration can be noticed the butt end of the weighing beam of a testing machine, and to the right is an end view of another machine. This apparatus is attached to the size and style of the Riehle 100,000-lb. testing machine, as shown in Fig. 2, which shows more fully the card attachment. One of these attachments will be in operation at the company's exhibit in the Machinery Building at the World's Columbian Exposition.

A powerful syndicate of iron and steel manufacturers of Cincinnati, Pittsburg, New York, Philadelphia, Boston, Birmingham, St. Louis and England is said to be in process of formation, which is to rival the combined Carnegie interests in a new plant for making iron and steel for railways, bridges, ships and armor-plate. The location of the plant is not yet fixed upon, but it it said that a capital of $75,000,000 to $100,000,000 will be required, and will be available. Only practical workers in steel and iron are to be admitted to the syndicate.

The comparative efficiency of labor at high altitudes is discussed by Mr. E. Lane in the "Nineteenth Century," in describing works on the summit tunnel of the Central Railway of Peru, 15,645 ft. above sea-level. He says that up to 800 to 10,000 ft. above the sea, the native laborers do about the same relative amount of work as at the sea-level; at 12,000 ft., the amount of work decreases; and at 14,000 to 16,000 ft., a full third must be deducted from the amount the same man would perform at sea-level. This applies to men brought up in the country. It takes about two weeks to accustom a man from the coast to do as efficient work at the higher altitudes; and his capacity gradually increases and reaches a maximum in a few weeks, or months, according to the constitution of the man. The majority of the laborers are Cholos, or Indians, born in the Sierra; it takes them a long time to become accustomed to coast work. Mules and horses work well up to 17,000 ft., and in about the same proportion as the human beings mentioned. The perpetual snow line lies here at an elevation of about 18,000 ft. above the sea.

The Broadway cable-cars, in New York, may be running in six weeks, say officers of the company. The first of the four Corliss engines, at the Broadway and Houston St. power-house, was set in motion this week. The other engines are being set up. The main cable for the middle section of the line, from Houston to 36th St., will be laid as soon as it can be brought from Trenton, N. J.

The new East River Bridge Co. is about to make a contract with the Bridge Construction Co., recently organized at Trenton, N. J. Mr. Frederick Uhlman, the chief promoter, expects that work will be at once commenced on bridge No. 1, starting at Delancey St., on the New York side.

THE HEAVIEST CAR IN AMERICA.

In our issue of March 23 (p. 279) we gave the principal facts concerning the Krupp 122-ton gun and the special car on which it is to be transported to Chicago, so far as they could be ascertained from press reports. We are indebted to Mr. Theo. N. Ely, Chief of Motive Power of the Pennsylvania R. R., for the accompanying elevation and perspective views of the car, which was designed and built at the Altoona shops of the Pennsylvania R. R., and an official statement of the particulars of chief interest concerning it.

It will be seen by the drawing that the wheel base is a little longer than was stated in our former article, being 80 ft. 3 ins., making the load per ft. 5,545 lbs. The comparison which we made between the loads produced by this car and those called for by Cooper's Specifications is practically correct. The following are the weights of the separate portions of the car and its load:

	Wt. lbs.
Long bridge carrying gun	47,000
Each short bridge	14,400
Each 8-wheel car	24,800
Total weight of car	175,000
Weight of gun	270,000
Total weight of loaded car	445,000
Weight per foot of wheel base	5,545

The whole car is designed for a weight of 285,000 lbs., which gives an ample margin for the fastenings by which the gun is secured. The entire car is built of steel boiler plate, except the center plates and center bearings, which are steel castings, and the running gear. The gun is supported on the main bridge by two supports which fit closely around the trunnion jacket. In addition to these two supports, to avoid any vibration in transit the muzzle of the gun is secured by wedge-shaped oak blocks set in cast iron shoes and drawn up to the muzzle by right and left hand screws. The long bridge has a span of 50 ft. c. to c. of bearings. It rests on side bearings on the shorter bridges, and these rest on center plates on each 8-wheel truck. As seen by the drawings, the truck frames are of riveted steel and are of great rigidity. The journals are 4½ × 9 ins., and special wheels are used 37½ ins. in diameter with wrought iron centers and steel tires.

The draft rigging is made especially strong. The car has Janney couplers at each end and Westinghouse air brakes with a shoe on every wheel. The air cylinder on each car is 14 ins. in diameter. National hollow brake beams with Christie brake heads and shoes are used. The load on the wheels is equalized by 32 elliptic springs of 36 ins. span. Each spring has 18 leaves, each 3½ ins. wide and ⅜ in. thick. The dimensions of the car over all are: Length, 90 ft. 9 ins.; width, 9 ft. 10 ins.; height, 9 ft. 9¼ ins. The minimum curve around which the car is designed to safely pass is 18°.

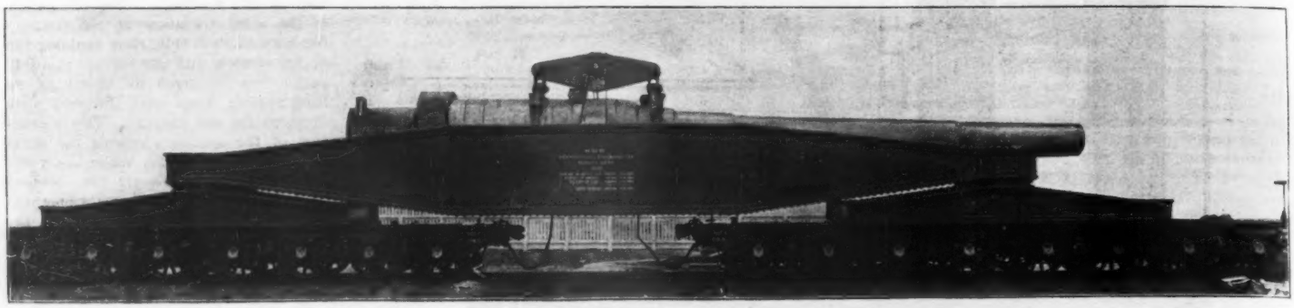

FIG. 1. SPECIAL CAR FOR TRANSPORTING 122-TON KRUPP GUN TO CHICAGO.
Weight of Car, 175,000 Lbs.; Capacity, 285,000 Lbs. Built at Altoona Shops, Pennsylvania R. R.

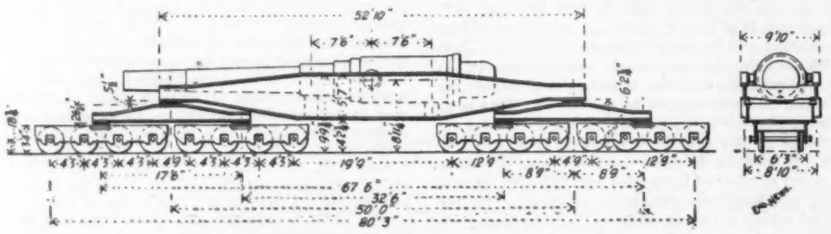

FIG. 2. ELEVATION OF 285,000-LB. CAR.

NOTES FROM RECENT WATER-WORKS REPORTS.

The water commissioners of Taunton, Mass., according to their last annual report, have had in use 1,242 meters of 19 different kinds, and during the past ten years have made 92 tests for accuracy. Of the 92 tests made, 21 showed the meter to register correctly, 36 showed an over and 35 an under-registration. The maximum over-registration was 4.6%, the minimum 0.1% and the average, 1.69%. The minimum under-registration was 0.2%, the maximum 25% and the average about 4.25%. The average of the 92 tests gave an under-registration of 0.97%. Nov. 30, 1892, there were in use at Taunton 1,131 meters, 111 of the total number put in use having either been worn out or discontinued. The report gives the specifications for the new conduit from the Lakeville Ponds now in progress of construction, with Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., of Boston, as Consulting Engineer. Mr. Geo. F. Chace is Superintendent of the Taunton Water-Works.

A committee of the Advance Club, of Providence, R. I., recently reported on the sanitary condition of the water supply of that city. They state that the Pawtuxet River, from which the supply is drawn, acts as the natural sewer for over 200 square miles of the most thickly populated territory of the United States, according to the last United States census. The committee condemns the river as a source of water supply, even with filtration, and recommends that a supply be drawn from the south branch of the river above Washington. The committee makes the following surprising statement regarding filtration:

> Your committee has consulted with practical chemists, and finds that not even the slowest and most careful filtration will change the chemical condition of water, and that disease germs are not removed by any process of filtration to them known—in fact, that nothing but sterilization by heat will destroy these germs.

A greater knowledge of the subject under discussion would have prevented such ridiculous statements as these, which show more zeal for a pure water supply than wisdom in the methods practiced to obtain it. Mr. Samuel W. Kilvert is secretary of the Advance Club.

The following testimony regarding meters as a preventive of a water famine is from the last report of the water commissioners of Middletown, Conn., W. F. Barrows being president:

> There have been 32 meters put in during the year, mostly in factories, making a total of 58 meters now in use. The meters are all owned by the city.
>
> The large consumers are now metered, and they have reduced their consumption from 20 to 70% without affecting their industries to any extent, and without causing them much inconvenience.
>
> The necessity for adopting measures to curtail the waste of water has been fully demonstrated this year. The quantity of water saved by the use of meters is so large that we have been saved from a water famine by their use, and probably from a large expenditure to secure a temporary supply of water.

A report on an additional water supply, by Mr. Geo. H. Bishop, C. E., of Middletown, is included with the report of the commissioners. Mr. Bishop recommends the construction of two storage reservoirs and a supply main.

Engineering and chemical reports on a new water supply for Troy, N. Y., have been made recently by Nathan Sweet and Wm. G. Raymond and by Prof. Wm P. Mason, respectively. The reports contain estimates of cost and chemical analyses.

A filtering, or purification, plant is proposed at Wilmington, Del., according to the last annual report of Mr. J. A. Bond, Chief Engineer of the Water Department, in which water will be passed through five 16 × 130-ft. beds of iron punchings, supplemented by previous aeration. The plant is designed to purify 10,000,000 gallons per day.

A report on the Cincinnati water-works was recently made by Mr. Geo. McLaughlin, Special Examiner. The report has been published in pamphlet form, and its criticisms have been discussed by Mr. W. P. Tharp, Superintendent of the works, in the last report of the President of the Board of Administration. Those interested in the controversy, which relates chiefly to the economy and efficiency of the operations of the works, are referred to the two reports. One remarkable fact is brought out by the examiner's report, and that is, that the total amount of uncollected bills for water rents in 1891 was less than $1,000, there having been some 85,000 bills, and a total income of $733,905. As the rents were assessed in advance, and the water shut off in from 30 to 60 days for non-payment, the actual loss was much less.

As a matter of interest it may be mentioned that since 1892, when the works were in charge of a board of public works, there have been five changes in the management of the Cincinnati water-works, as follows: To Board of Public Affairs, June 1, 1886; to Board of Public Improvements, March 17, 1890; to Board of City Affairs, Nov. 11, 1890; back to Board of Public Improvements, March 13, 1891; to the present Board of Administration, May 4, 1891. Recent improvements at the pumping stations, some of which were noted in our issue of March 12, 1892, have reduced the operating expenses of the works.

The usual detailed figures regarding the cost of constructing and operating the water-works of Columbus, O., given in the last report of the works, cover this year 22 years of construction and 20 years of operation.

The report also contains the results of a twelve-hour test of one of the two new 7,500,000-gallon Gas-

kill triple-expansion pumping engines, by Messrs. Robt. B. Collier and S. P. Bush. The contract called for the above capacity against a head of 185 ft., exclusive of friction in pumps and connecting pipes, a piston speed of 135 ft. per minute and a duty of 120,000,000 ft.-lbs., based on a consumption of 100 lbs. of coal and an evaporation of 10 lbs. of water per 1 lb. of coal, from and at the temperature of the feed, with a pressure of 120 lbs. per sq. in. for fire service. The test showed a capacity of 7,705,410 gallons per day, with a piston speed of 129.28 ft. and a duty (foot-pounds per 1,000 lbs. of water) of 131,205,000. Mr. W. H. McAlpine is superintendent of the works.

A 24,000,000-gallon Allis triple expansion engine has been contracted for by the water commissioners of Detroit, according to their last annual report. The engine guaranteed for this capacity against a head of 116 to 135 ft., and is to develop a duty of 120,000,000 ft.-lbs. per 100 lbs. of best anthracite coal consumed in a 24-hours test, and 120,000,000 gallons in a 30-days continuous test, steam to be applied at a pressure of 125 lbs. per sq. in. The high-pressure steam cylinder will be 28, the intermediate 48, and the low-pressure 74 ins. in diameter, all of 60-in. stroke. Mr. L. N. Case is secretary of the Detroit works.

A supplement in the form of a separate pamphlet to the last annual report of the water commissioners of Saginaw, Mich., contains reports on a new supply for the western taxing district from the Tittabawassee River, by Messrs R. W. Roberts, City Engineer; W. R. Coats, C. E., of Kalamazoo, and Mr. J. D. Cook, C. E., of Toledo, O. Mr. Cook submitted plans for new works, but a decision regarding construction was postponed until the beginning of 1893, in order to investigate the possibility of a supply from driven wells. Mr. John F. Maher is secretary of the works.

An interesting comparison of the cost of some of the elements of water-works construction some 20 years ago and at the present time is given in the last annual report of the department of public works of Providence, R. I., of which Mr. Robt. E. Smith is commissioner. The same prices paid in 1869 to 1872, and in 1892, for the same labor and material are as follows:

	1869 to 1872.	1892.
Labor, per day	$2.00 to $2.25	$1.35 to $1.50
Masons, per day	6.50	3.50
Single teams, per day	3.50 to 4.00	2.50
Double teams, per day	5.50	4.00
Cast iron water pipe, per ton	51.50 to 72.70	24.00
Special castings, per pound	4 and 5 cts.	2½ cts.

The total number of meters in use in connection with the Providence water-works at the close of 1892 was 10,908, against 16,658 service stops.

The number of meters, according to size and make was as follows:

	Size, inches.							
Kind.	⅝.	¾.	1.	1½.	2.	3.	4.	Total.
Ball & Fitts, piston	3,068	601	147	30	5	..	..	3,857
Ball & Fitts, rotary	....	...	22	22	3	5	2	54
Crown.	5,084	650	175	75	22	10	9	6,034
Fales, Jenks & Sons	1	1	1	..	..	..	..	3
Thompson.	792	103	22	24	3	3	1	948
Worthington.	9	1	..	..	1	..	1	12
Total.	8,954	1,365	367	157	34	18	13	10,908

The total length of service pipes laid at Providence in the 16 years ending Dec. 31, 1892, was 164,892 ft., or about 31 miles, of which about 80% were ⅝-in. services, some 6% ½-in. and the remainder ¾, 1, 1¼ and 1½ ins., there being only 443 ft. of the latter.

NOTES ON BRIDGE ACCIDENTS.

A large number of bridge accidents are reported in our columns, but many such accidents, mainly those of minor importance, do not come to our notice. We are indebted Mr. Chas. F. Stowell, M. Am. Soc. C. E., Engineer of the New York State Railroad Commission, for the following notes of recent accidents:

On March 10 two highway bridges near Addison, N. Y., were carried away by ice. A new iron foot bridge at Owosso, Mich., was also wrecked in the same manner. Floods in the Missouri, Platte and Loup rivers carried out a number of spans on the Burlington & Missouri River and Union Pacific railways and many highway bridges. A man on one of the Union Pacific bridges was drowned. A bridge over Davis Creek, near Sweet Springs, Mo., broke down March 24, while three men were crossing in a spring wagon. The men were injured, and threaten a suit against the county. While an iron railway bridge was being erected over Tremont St., Massillon, O., on the Pittsburg, Ft. Wayne & Chicago R. R., the jar of a passing train on an adjoining bridge caused the partly-completed structure to fall March 22. Floods in the Calaveras and Mokelumne rivers, California, carried away several bridges March 19. On March 28 an old wooden bridge at Wheeling, W. Va., was being taken down, when it suddenly fell. On March 30 a long wooden bridge on the Raleigh & Augusta R. R., near Raleigh, N. C., was burned. The bridge was about 600 ft. long, and was covered. It was worth $25,000 and insured for $19,000. It was supposed to have been set on fire by a passing train. It was 20 years old. Floods in Montana in the latter part of March carried away four Northern Pacific R. R. bridges near Helena. A new highway bridge over the Eel River, near Ukiah, Cal., was partly wrecked, March 30, by the abutments sliding. It was built by San Francisco parties and guaranteed for five years. A bridge over Black Bear River, near Red Rock Station, Oklahoma, on the Atchison, Topeka & Santa Fe R. R., was burned April 2. It was said to have been fired by boomers, who objected to the unloading of cattle at Ponca; and, wishing to have the transfer made nearer their own locality, took this effectual means of showing their disapproval and stopping the traffic. A bridge on the Philadelphia & Reading R. R., near Barnesville, Pa., caught fire, April 2, from the sparks of a passing locomotive and was destroyed. Floods in South Dakota carried away nine highway bridges near Aberdeen early in April. A small wooden bridge near Chillicothe, O., broke down, March 29, under a traction engine. On April 4 a freight train on the Jacksonville, Tampa & Key West R. R. ran into a partly-open draw, at Buffalo Bluff, on the St. Johns River, seven miles from Palatka. The engine and seven cars were wrecked and half the the bridge destroyed. Three men were killed. The bridge was an iron one. (Eng. News, April 13). On April 7 a passenger train struck some timbers which had been blown across the track on the bridge over Wildcat Creek, near Rossville, Ind., on the Louisville, New Albany & Chicago R. R. One span of the iron bridge went down, carrying the engine and killing the fireman. Sixty feet of a toll bridge across Saratoga Lake, near Tolmie's Lake House, was carried away by ice April 3.

THE PAINTING OF WOOD AND IRON STRUCTURES.

In a paper recently read before the Engineers' Club of Philadelphia, Mr. Edward H. Brown makes some observations concerning the use of paint on engineering constructions which should command the attention of all engineers, and especially those who have to do with structural ironwork. The question of the proper paint to be used on different classes of engineering constructions has hardly received the attention from engineers in general which its importance warrants. It is true, indeed, that some of our larger railway companies have gone into the subject in a scientific manner and developed it to a par with other questions of construction and maintenance, but ordinarily the painting of structural work is dismissed with the words "two coats of mineral paint," or "three coats of red lead and linseed oil," in the specifications. The following is an abstract of Mr. Brown's paper:

A paint, properly speaking, consists of two portions—the pigment and the vehicle or binder. The pigment is a solid substance which is more or less finely ground, so as to be capable (when mixed with the vehicle) of being spread out in a thin layer or coating over the surface to be painted. The vehicle or binder is the liquid in which the pigment is mixed or ground, which serves to spread the pigment over the surface to be painted, and which also holds it to that surface. For ordinary painting, intended to stand the action of the weather, by far the most generally useful vehicle is linseed oil.

Linseed oil possesses the peculiar property of drying by uniting with the oxygen of the air to form a tough, leather-like compound called linoxin. In doing this it loses but little, if any, weight, whatever weight may have been lost by evaporation being supplied by the additional weight of the added oxygen. This drying or oxydizing process seems to take about thirty days to complete, when the oil is spread out in a very thin layer. It has generally been supposed that linseed oil formed a waterproof and water-repelling coating on any surface to which it is applied; but Dr. Charles B. Dudley, the Chief Chemist of the Pennsylvania R. R., in a recent series of experiments made by him, seems to have proved that this is a misapprehension, and that in reality it is an absorbent of moisture, and will transmit air through it. Moreover, in the process of drying it has an oxidizing tendency on the surface upon which it is placed. While these characteristics of linseed oil are rather an advantage than otherwise in the case of paints to be applied to wooden surfaces, they make it a dangerous vehicle to use in paint intended to be applied to iron construction, where absolute impenetrability to gases and moisture is essential in order to prevent the metal from being eaten away by rust. Hence, it would seem that for a perfect paint for use on ironwork we must look for a vehicle which, when dry, is impervious to moisture and gases, and, moreover, one which will be chemically inert and in no way aid the process of rusting. Another very important property of linseed oil which makes it valuable for paintmaking is the fact that it is capable of uniting with various metallic bases (usually in the form of carbonates or oxides) to form a linseed oil soap.

White lead, or the hydrate-carbonate of lead, the pigment usually used in house-painting, and generally esteemed to be of most value, unites with the oil to form a lead soap, on exposure to the oxygen of the air, thus forming an elastic skin of paint over the surface to which it has been applied. In time, by the gradual action of water, alternating with the heat of the sun, and aided more or less by the sulphur and other gases in the air, particularly in and about large cities, this soap gradually decomposes, and the paint begins to chalk or flour off. Zinc white, or the oxide of zinc, also unites with linseed oil to form a zinc soap, which is harder and more brittle than the lead soap, and has a tendency to contract or pull together when drying, and also to peel off in time. It has not the same tendency to chalk and flour that the white lead soap has. Zinc white has, therefore, valuable pigment properties, but these seem to be most fully developed when this pigment is used in conjunction with white lead, and then to the best advantage when the mixture is used as a final coat over an elastic undercoating of white lead.

On account of the peculiar chemical activity of a white lead and linseed oil paint, which causes its final decay, many experiments have been made looking to the substitution of some chemically inert substance for the more active carbonate of lead; but so far no other white base has been discovered which possesses at the same time the other properties which render white lead valuable, namely, covering and spreading capacity. It seems, therefore, probable that if a better paint than lead and oil is desired, experiments will have to be directed rather toward securing an inert vehicle than toward an inert base.

Of the inert pigments, lampblack is probably the most valuable. Being almost pure carbon, it is practicably unchangeable except by fire. It has a peculiar property of absorbing great quantities of linseed oil and hence of spreading over a large surface. French ochre, an earth pigment, containing more or less of the hydrated oxide of iron, possesses the property of absorbing a large quantity of oil, and hence has considerable spreading capacity, and also holds very firmly to any wooden surface to which it may be applied. As this makes a reasonably cheap paint, it is very good to use on rough work where the yellow or yellow-brown color is not objectionable. It has the merit of great durability, and repels water well. It should be ground in raw linseed oil, and if a thinner is required, care should be taken that boiled oil is not used. The raw oil possesses greater penetrative properties and carries the ochre farther into the pores of the wood. Ochre has been recommended by some as a primer for use under subsequent coats of white lead. While it has undoubtedly the property of holding fast to the wood itself, it does not hold as well to the white lead coats, which sometimes separate from it in flakes. This could probably be avoided by the addition of a certain proportion of white lead to the ochre for the priming coat.

The various mineral and metallic paints are almost all natural or artificial iron oxides. While these are cheap and useful for painting rough wooden structures, they are sometimes really quite dangerous for application to iron work, because instead of preventing oxidation they are apt to further it. Mineral paints are usually iron oxides, similar in their nature to rust. Rust is a hydrated iron oxide, and seems to possess the peculiar faculty of spreading from a center, in some way acting on the adjacent iron to form additional rust; moreover, the artificial metallic paints are frequently made from copperas and from pyrites, and are apt to contain sulphuric acid or sulphur in a state readily oxidizable into sulphuric acid, which is another source of danger to an iron surface. On wood, however, they are permanent in color and exceedingly preservative. Coal tar is much used as a paint for the

roughest class of work, both wood and iron, in the latter case especially for cast iron pipes, smokestacks and work to be buried underground. It has the nature both of resin and an oil. Mueldер, in a series of experiments, found that it continually decreases in weight, losing from two to five per cent. in 87 days. It has also the disadvantage of becoming exceedingly brittle by the action of cold and softening at 115° F. Asphalt permits of somewhat wider range of temperature, but otherwise exhibits the same peculiarities. These substances, while they last, are probably the most valuable of paints, especially under water; but they are unfortunate in their tendency to flow or crawl on the surface to which they are applied, finally leaving the upper portions almost or quite bare. This is the case even under ground.

Tin or metal roofs are problems requiring most careful consideration on the part of both engineer and architect. Frequently the tin is allowed to rust before the coat of paint is given, so as to make the paint hold easier, forgetting that the tin is intended to preserve the iron from rust, and when once the tin has gone and the rusting process has commenced, no subsequent coating of paint can prevent it from eating its way through the thin sheet of iron. At the last convention of the Master Painters' Association of New Jersey, this subject was thoroughly discussed, and the general sense of the meeting seemed to be that the best method of painting a tin roof was to carefully remove all traces of oil or grease from the surface of the tin while it was yet bright, with benzine; then to apply a coat of red lead and linseed oil, or the best quality of metallic paint, and to follow this with one or two coats of graphite paint. The graphite is almost unchangeable by atmospheric action, and is remarkably waterproof as well.

To determine the proper material to use on structural iron work is perhaps the most important problem that confronts the engineer of construction to-day. In our modern many-storied buildings, this iron work is buried beneath brick and terra-cotta, so that it is impossible to observe its condition. Who can say that the causes of rust and decay are less active here than they are when the same material is exposed? Again, our bridges and the roof trusses in our railway stations are exposed to constant fumes from the locomotives beneath them. The smoke is more or less charged with sulphur gases, which, in a moist condition of the atmosphere, are rapidly changed into the actively destructive sulphuric acid. Already the roof trusses in the Broad Street Station, Philadelphia, Pa., have been seriously impaired, and we have had shown to the Club at various times a number of examples of rods and plates from overhead bridges, which have been nearly eaten through by the action of these gases. (An especially interesting example of such corrosion was illustrated in our issue of Jan. 29, 1893.—Ed.)

In house painting the most important thing to consider is the permanency and durability of the paint itself. In constructive iron work, on the contrary, the condition of the surface under the coating of paint becomes highly important. To the superficial observer the painted surface may appear as perfect as the day it was put on, yet underneath it the iron may be slowly, yet none the less surely, rusting away. In fact, it sometimes happens that the paint itself proves an active destructive agency for injuring the iron. This is, as said above, specially true of certain of the metallic paints containing sulphur in a form readily oxidizable to sulphuric acid, or of certain of the oxides, such as Venetian red, which are practically rust themselves and give off oxygen to the iron, absorbing more from the outer air to replace that which has been lost. It is said that a similar process takes place during the oxidation of linseed oil, which charges it to linoxin. Were all the oil to unite with the pigment base to form a soap, then none of its oxygen could be given off to rust the iron; but in the case of white lead, according to Condit, it is only the water lead (the hydrate) which forms a soap with the oil, while the carbon lead (the carbonate) remains practically unchanged, being held, as it were, in suspension in the oxidized vehicle. Hence a large portion of the oil, in drying, is free to give up its oxygen to the iron, absorbing more from the air, and thus become an active rust-producing agent. While this theory may not be correct, it is certain that a priming coat of white lead is not a good preservative of iron, nor does it hold well to it.

Red lead, from the fact that it dries up linseed oil almost entirely by saponification, forming a pure lead soap, and that there is, therefore, none of that oxidation of the oil which takes place in the presence of pigments wholly inert, or which only partially combine with it, has long been regarded as the best possible preservative for clean dry iron. But in order to be most effective, the iron must be perfectly clean and free from any suspicions of rust, and absolutely dry. Red lead should be perfectly pure, and of the best and most careful preparation. That from any well known corroding house may be depended upon for purity, but not always for quality. It is simply a red oxide of lead. The best type is orange mineral, which is made by roasting white lead. On account of its expense, this is not so frequently used as it would deserve. Red lead proper is made directly from the metal, which is first oxidized to the yellow litharge, and then to the red oxide. This, however, does not give as good a paint as that made from the scrap, settlings and tailings of the white lead works. As red lead saponifies very quickly with linseed oil, it must be used within a few days after being ground, and, moreover, it is rather difficult to work. Hence there is great temptation to the unscrupulous painter to add some substance, such as whiting, to it in order to make it work freer, as well as to cost less money for material.

Before painting iron work it is very essential that the iron itself should be absolutely free from rust. Rust has the peculiar property of spreading and extending from a center, if there be the slightest chance to do so. Hence, a small amount of rust on the iron may grow under the surface of the paint, especially if it be true, as Dr. Dudley asserts, that linseed oil is permeable by air and moisture, and in time the paint will be flaked off by the rust underneath, thus gradually exposing the bare surface of the iron to the action of its destroying agents, oxygen in the presence of water. It is necessary to remove all the scale possible from wrought iron by means of stiff wire brushes, and then to remove the rust by a pickle of very dilute acid, which must afterward be thoroughly washed off before the paint is applied. The surface of the iron should be dry, and at least moderately warmed before it is primed. Hence, the specifications usually call for the priming with red lead, to be done by the iron manufacturer, before its delivery to the job. It has been suggested that rust may be quickly and thoroughly removed from iron by coal oil. This should afterward be washed from the surface with benzine, which should be allowed to evaporate before painting, otherwise the coal oil, being practically non-drying, would inevitably cause the paint to peel from the metal. Red lead, to secure the best results, should be thoroughly incorporated with the oil in a mill, and not merely stirred in by hand. While the use of red lead appears to be very general, its success depends so very much upon the care which the workmen take in preparing the surface to be painted, that it seems desirable that some paint should be found to take its place, which may be applied either to a hot or cold surface, and which should be ground in a vehicle rendered practically inert, so that it would not in itself tend to promote rusting already begun, or to start it on a surface where it had not already commenced. This vehicle, if it be possible, should be one which would be absolutely impervious to gases or moisture. With this idea, a well known firm of paint manufacturers of this city, months ago, began a series of investigations into the subject, and, after many experiments, produced a paint which they have called "Anti-Rust." So far as the most careful experiments would seem to indicate, the vehicle, when dry, forms an absolutely impervious coating to gases and moisture. It has been prepared with three pigment bases: a brown oxide of iron, which is not highly recommended, as it is not the highest form of oxide, and might, perhaps, be subject to change; the bright red ferric oxide, 98% pure, which some of the most eminent German authorities of the present day believe to be the most suitable pigment for painting iron, since it is practically unchangeable, and being itself iron, there can be no electric action between this and the metallic surface to which it is applied. The third pigment, and, in the judgment of Dr. Dudley, the best, is black, which seems to be chemically and electrically inert. Using this paint as an outer covering over a priming coat of pure red lead would probably give the best protection to iron, combining thus the advantages of both paint minerals.

One very important point in painting engineering constructions is the specification under which the work is done; too much care cannot be given to its proper preparation; the engineer should not only consider the scientific names of things, but what those things may mean in the trade—for example, he may specify iron oxide paint, red or brown, expecting to get the pure oxide. In the trade such a specification would indicate merely that he desired a paint material tinted red or brown with iron oxide, and would not show at all that he desired a pure pigment, unless it was so specifically stated. Unless he be thoroughly familiar with all the technical terms and trade designations, his best plan would be to consult a manufacturer on whose judgment and honesty he can rely, and by his aid draw up a suitable specification for the work on hand. It seems to me an entirely false view of the matter which induces some engineers and architects to refrain from specifying definite brands or makes of materials. When they know these to be good and feel certain that by specifying a certain brand they can insure for their client the employment of good and pure material, it then becomes their duty to do so.

The "Campania," the new Cunard steamship, is said to have attained a speed of 23.5 knots, or fully 27 miles per hour, in her trial trip on the Clyde on April 15. She is to leave Liverpool for New York on April 22.

INTERCEPTING VALVE FOR COMPOUND LOCOMOTIVES.

That the compound locomotive has proved its efficiency and economy in regular service is conclusively shown by the great extent to which compound engines of different types and for all classes of service are being adopted in this country. It is no longer a matter of experiment, but many roads which have experimented with these engines have placed large orders for compound engines. The natural result of this is that most of the locomotive builders have taken up the construction of compound engines, generally introducing some special details of their own, and several of these different engines have been described in our columns. The builders which have done the greatest amount of work of this kind are the Baldwin Locomotive Works, of Philadelphia, Pa., which make a specialty of the Vauclain four-cylinder system (Eng. News, Feb. 20 and Dec. 8, 1892), and the Schenectady Locomotive Works, of Schenectady, N. Y., which make a specialty of the Mallet, or two-cylinder, system (Eng. News, April 28, 1892), but use a form of intercepting valve invented by Mr. A. J. Pitkin, superintendent of the works. The form of intercepting valve used by the Rhode Island Locomotive Works, Providence, R. I., for two-cylinder compound locomotives was illustrated and described in our issue of Dec. 12, 1891.

In Mr. Pitkin's first intercepting valve the opening was effected by the pressure of steam in the receiver acting directly upon the valve, but in the present form of the valve the opening and closing are effected by separate mechanism, operated by the pressure in the receiver for opening, and by live steam for closing. The purpose aimed at in the design was to produce an automatic valve to control the admission of live steam to the low-pressure cylinder in starting, and which could be kept steam tight to prevent leakage of live steam when the engine is working compound, as any such leakage affects the economy due to the compound system. In the older form of valve this leakage was considerable, as steam packing could not be used, and the piston valve was the only means employed to shut out the live steam. This leakage increased the back pressure on the high-pressure piston, and sometimes prevented the engine from starting readily.

In the valve illustrated in the accompanying cuts, live steam is admitted underneath the intercepting valve in starting, thus pressing the valve up against the receiver ports, and closing the passages tight so that no live steam can leak into the receiver when the engine is starting. When the engine is working compound the live steam does not reach the intercepting valve, but is shut off by a separate poppet valve. Fig. 1 is a vertical section through the intercepting valve. Fig. 2 is a horizontal section showing the mechanism for operating the valve and for regulating the admission of live steam to the low-pressure cylinder. In both figures the valve is shown open, leaving the steam passages unobstructed, which is the position occupied when the engine is working compound, and in this position there is no means for live steam to pass to the low-pressure cylinder. A is the intercepting valve, operated directly by the piston valve B, and the steam passages are shown at C C.

In starting, the operation is a follows: The pipe D is connected at E with the steam pipe leading from the boiler to the high-pressure steam chest. On the throttle-valve being opened steam passes through the pipe D into a small supplementary steam chest which leads it into the auxiliary steam chest F, between the pistons G H. The piston H in this steam chest being of greater area than the piston G the valve J is moved to the right, opening the left port. The steam passing through that port pushes the piston B to the right, moving in the same direction the intercepting valve A, and closing the steam passages C. In moving to the right, the piston rod of the intercepting valve operates the elbow lever K, which strikes the rod of the poppet valve L and admits live steam through the port M and passage N into the cylinder O, and thence through the port P to the steam chest of the low-pressure cylinder. The intercepting valve being now closed, the tendency of the live steam is to push it up against the seat.

The change from simple to compound working is

effected automatically. When a certain pressure is attained in the pipe that leads the exhaust steam from the high-pressure to the low-pressure cylinders (that is in the receiver), the steam passes through the pipe Q to the supplementary valve, and being sufficient to overcome the force exerted by the high-pressure steam on a smaller surface moves the valve back and opens the passage that admits steam to the right of piston H of the auxiliary valve. This is forced to the left, admitting steam to the right of piston B, which is moved to the position shown in the illustrations. At the instant the intercepting valve and its connections move to the left the elbow lever K lets

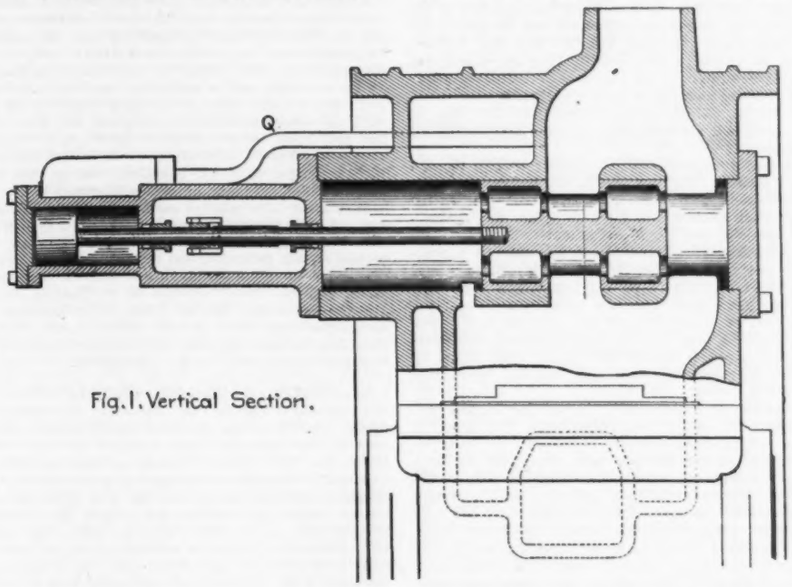

Fig. 1. Vertical Section.

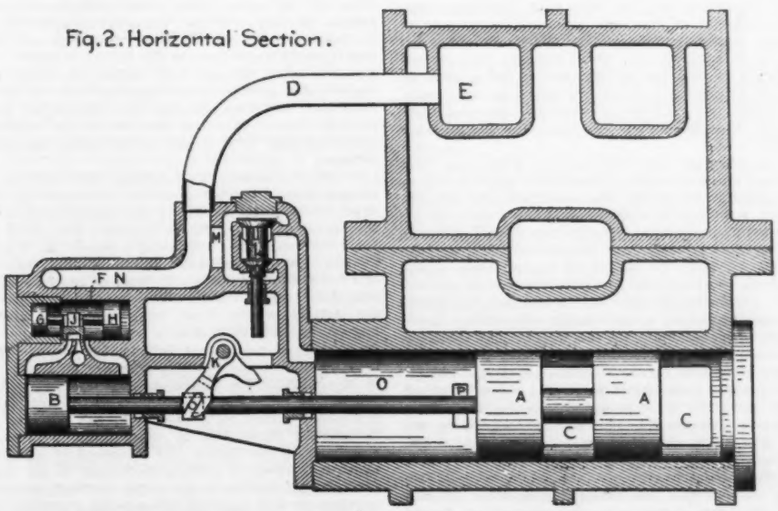

Fig. 2. Horizontal Section.

INTERCEPTING VALVE FOR TWO-CYLINDER COMPOUND LOCOMOTIVES.
A. J. Pitkin, Superintendent, Schenectady Locomotive Works.

the poppet valve L drop, and direct steam is cut off from the intercepting valve and the low-pressure cylinder. The operations are very simple, and the valve has been found very satisfactory in extensive service.

Two new Atlantic steamers, designed to eclipse in size and speed even the mammoth new Cunarders, are reported as being under consideration for the White Star line, and negotiations for their construction are said to have been closed with Harland & Wolff, of Belfast, Ireland. Press reports state that the new vessels will have triple screws, 40,000-HP. engines, and will be designed for a speed of 27 knots. Doubtless, if the White Star line is planning new fast liners, it will aim to eclipse anything which has yet been built; so, while the figures may be exaggerated, there is nothing improbable in the general substance of the story.

PERSONALS.

Mr. Wm. Steyh, City Engineer, Burlington, Ia., has been re-elected, making this his eleventh year.

Mr. David Preston, Mechanical Superintendent of the Canadian Pacific Ry., died at Montreal, April 13.

Mr. James B. Gass has been re-elected City Engineer and Superintendent of Sewers of Fort Smith, Ark.

Mr. George E. Simpson, Vice-President of the National Water-Works Co., died at Kansas City, Mo., April 11.

Mr. J. W. Addis has been appointed Superintendent of Motive Power and Rolling Stock of the Texas & Pacific Ry., with headquarters at Marshall, Tex.

Mr. H. T. Douglas, Jr., Chief Engineer of the Ohio Southern R. R., has resigned, and is succeeded by Capt. R. L. Cobb, formerly Chief Engineer of the Louisville & Nashville R. R.

Mr. C. F. W. Felt recently Office Engineer with the Rio Grande Southern R. R., has accepted the position of Division Engineer on the Northern Division of the Gulf, Colorado & Santa Fe Ry.

Mr. Jeremiah O'Rourke, of Newark, N. J., has been appointed Supervising Architect of the Treasury Department, vice Mr. W. J. Edbrooke, resigned. He is a member of the American Institute of Architects.

Mr. Lewis Kingman has been reappointed City Engineer of Topeka, Kan. He has served four years, and this appointment is for two years. Some details of the municipal work were given in our issue of March 23 and April 13.

Mr. Daniel Pike, long known as a maker of scientific instruments, died in New Providence, N. J., on April 16, aged 80 years. He was the last surviving member of the firm of Benjamin Pike's Sons, established in 1804, in Wall St., New York.

Mr. James Howell has been elected President of the new Board of Trustees of the Brooklyn Bridge, at a salary of $5,000 per annum. Mr. E. V. Skinner was elected as Vice-President, and Mr. Beam, Secretary, and Mr. Clark, Treasurer, were re-elected for a term of five years.

Mr. Emile Low, M. Am. Soc. C. E., of Cedar Bluff, Va., is an applicant for the position of consul to Paso del Norte, Mexico. He was connected with the Norfolk & Western R. R. during the construction of its Clinch Valley Division, and latterly as engineer in charge of coal operations on the Ohio extension. Formerly he was engaged on the construction of the Mexican Central Ry.

Mr. Schuyler Hazard, Engineer of Maintenance of Way on the Cleveland Division of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed Assistant Engineer in charge of new work, with office at Cincinnati, O., and has been succeeded by Mr. Stanley W. Hayes. He will report to receive instructions from the Chief Engineer. Mr. W. M. Duane, Engineer of Maintenance of Way on the Indianapolis Division, has been appointed Engineer of Maintenance of Way of the St. Louis Division, with headquarters at Mattoon, Ill., vice Mr. H. M. Waite, resigned. The Sandusky Division has been merged into the Indianapolis Division, under charge of Mr. F. Woodbridge, Engineer of Maintenance of Way on the Sandusky Division, with headquarters at Bellefontaine, O.

Mr. Charles J. Liernur, the inventor of the Liernur, or separation, system of house drainage, died in Berlin a few weeks ago. Mr. Liernur was born in Holland, but came to the United States early in life and settled in the South. During the Civil War he was a captain of engineers in the Confederate Army. About 1866 he returned to Holland and soon after developed his peculiar system of house-drainage, which was adopted by the city of Amsterdam and in other places. Briefly described, this system consisted of the separation of the house refuse from rain water, etc., and the conveyance of the solids to a distant point by exhausting the air from the iron pipe system communicating with the houses at certain hours in the day. The product was dried and sold as costly manure. His scheme has been superseded by more scientific methods, and Amsterdam is already planning to abandon its Liernur system of house-refuse disposal.

Capt. Chas. F. Powell, Engineer Corps U. S. A., has been appointed Engineer Commissioner of the District of Columbia, to succeed Captain Rossell, who has been granted a six months' leave of absence. Captain Powell, who is stationed at present at Sioux City, was born in Illinois in 1843, and enlisted in May, 1861, as a private in the 5th Wisconsin Regiment of Infantry. He served with credit in the army of the Potomac, and in 1863 he was appointed as a cadet-at-large to the Military Academy at West Point, and graduated in 1867 near the head of his class. He served with the engineer battalion at Willet's Point until 1871, and then was on duty as an officer of the Engineer Corps in the geodetic survey of the Northern lakes, the Mississippi River survey, and on river and harbor work in Oregon. He was promoted to Captain of Engineers June 17, 1881, and since that time has occupied various posts in Oregon, Washington and Idaho. Since October, 1890, he has been chiefly in charge of improvements of the Missouri River, from Great Falls, Mon., to Sioux City, Ia.

Mr. Adolphus Bonzano, Vice-President and Chief Engineer of the Phoenix Bridge Co., of Phoenixville, Pa., was the recipient of a testimonial on the part of the entire staff of the company on April 14, marking the 25th anniversary of his connection with the Phoenixville Bridge Works, and the goodwill and affection of the employes in the Phoenixville, Philadelphia and New York offices. The whole affair was arranged as a surprise to Mr. Bonzano, and on his return home he found his library decorated with flowers, and the staff assembled. Mr. M. G. Lippert, Chief of the Drafting Room, spoke of the long service of Mr. Bonzano and the resulting growth and prosperity of the bridge works, and then presented to him, in the name of the staff, an exquisite bronze bust of a young scholar of the 14th century, modeled by Picault, and exhibited at the Paris Salon of 1892. Mr. Bonzano's many friends, outside of his immediate staff, will join them in wishing him many happy returns of the day and continued prosperity in his engineering enterprises.

NEW PUBLICATIONS.

"JOURNAL OF THE IRON AND STEEL INSTITUTE." No. II., 1892. London and New York; E. & F. N. Spon; 12mo; cloth; pp. 574 + lxxvii.

This volume contains the papers read at the Liverpool meeting, reported in our issue of Oct. 27, 1892.

Those of most interest have already been reprinted or abstracted in Engineering News, except the exhaustive paper on alloys of iron and chromium, by Mr. R. A. Hadfield, and that by Mr. J. E. Stead, on "The Elimination of Sulphur from Iron." The last half of the book is devoted to a very fair digest of such matter in technical journals and the proceedings of technical societies, as is of most interest to the members of the Institute.

WATER-WORKS REPORTS.—The following water-works reports have been received, the names given being those of superintendents, unless otherwise stated:

Brattleboro, Vt., Special Committee on Additional Water Supply, B. D. Harris and others. Dover, N. H., W. D. Taylor; C. A. Fairbanks, Clerk. Fitchburg, Mass., T. C. Lovell; A. W. F. Brown, Registrar. Fall River, Mass., P. Kieran; P. D. Borden, Jr., City Engineer. Holliston, Mass., report of a sub-committee on the cost of the works of the Holliston Water Co., A. J. Cass, and others. Lawrence, Mass., A. H. Salisbury. New Bedford, Mass., R. C. P. Coggeshall. Newton, Mass., H. Nelson Hyle; A. F. Noyes, Engineer. Northampton, Mass., L. C. Wright. Plymouth, Mass., R. W. Bagnall. Springfield, Mass., J. C. Hancock. Taunton, Mass., Geo. F. Chace. Waltham, Mass., L. Brown, Clerk Water Commissioners. Wellesley, Mass., W. H. Vaughn; F. L. Fuller, C. E., Chairman. Pawtucket, R. I., Edwin Darling. Middletown, Conn., J. C. Broatch. Waterbury, Conn., Welton & Bonnett, Engineers. Binghamton, N. Y., Darwin Felter. Gloversville, N. Y., J. B. Tuckerman. Bridgeton, N. J., Timothy Woodruff. Bradford, Pa., S. D. Heffner. Wilmington, Del., Jos. A. Bond, Chief Engineer; John S. Grohe, Registrar. Cincinnati, O., Report of President of the Board of Administration, M. Aug. Herrmann; W. P. Tharp. Columbus, O., A. H. McAlpine. Bay City, Mich., E. L. Dunbar. Detroit, Mich., L. N. Case, Secretary. Saginaw, Mich., John F. Maher, Secretary. Minneapolis, Minn., F. T. Moody, Registrar; J. H. McConnell, Supervisor. Manhattan, Kan., E. C. Pfuetze.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting April 19 a paper by D. Bontecou was read on "Notes on the Cost of Operating Cable Railways." The writer stated that the information furnished by those who have built and operated such roads has not been in proportion to the importance of the subject, and that there has been much misinformation about the net results to be expected from a cable railway, inspired by commercial interests or by the tendency to generalize without sufficient study. He therefore presented certain facts and from them drew inferences as to some of the objections to the cable system. The cost of operation for a fast and frequent service is less with the cable than with any other form of traction; and the cost of first class construction is so large that a suitable amount of business is needed to make a cable road profitable.

The amount of gross receipts necessary to justify the expenditure of a given amount in building a road is not well understood; and the paper presented the facts as to cost of operation of a single system in Kansas City, during the last fiscal year, as representing the inferior limit of justifiable cable operation, the net earnings having been about 3½% on its cost, and the average number of passengers transported daily per mile of double track, 1,706. There are 8.54 miles of double track disposed as a trunk line in the business part of the city, with three diverging feeders; and the system is operated as three distinct lines with one common terminus; about two-thirds of the territory which is served is sparsely built up. There are three driving ropes, respectively, 14,200, 29,500 and 31,000 ft. long. The power-house is at the junction of two of the lines, and a fourth rope 9,200 ft. long is driven from a separate house.

The speed of the cars is 7.8, 9.85 and 10.25 miles per hour. There are 716° of double-track curvature, with no grades exceeding 10%. The rope is 1¼ ins. diameter and is carried on 12-in. pulleys in a conduit 36 ins. deep. The combination cars each seat 40 persons, run on two four-wheel trucks with 22-in. wheels and have side-bearing grips. The plant at the main power-house consists of an electric light plant, with one 36 × 48-in. and one 32 × 48-in. simple, non-condensing engine, which are run alternately by three 200-HP. boilers. The driving drums are 12 and 14 ft. diameter. In the branch power-house there are a 24 × 48-in. simple engine and two 175-HP. boilers. The equipment comprises 99 combination cars, and the system has been in operation four years. The total cost of the plant is $1,905,989, and, exclusive of the cost of franchise and grading new streets, the cost is $223,184 per mile.

The total cost of operation, including injuries to persons and property, secret service, general miscellaneous expenses and taxes, and all other items of expense, was $195,241:

Total car-mileage	2,830,732
Number of passengers carried	5,318,410
Number of passengers per car-mile	1.9
Average number of cars run daily	61

This shows a net cost of 6.9 cts. per car-mile, or, if interest at 5% be added, 11.02 cts. A larger amount of business would possibly increase the cost per car-mile ½%. The fuel used is bituminous Kansas coal, with about 18% ash. It consists of nut and slack coal mixed in the proportion of 3 to 2, and costs $2.01¼ per ton of 2,000 lbs. The writer estimated 2.1 lbs. of coal used per ton-mile, and an average of about 575 HP. as developed by the two engines.

The total indicated engine friction is 64 HP., and the total resistance of all the ropes when no cars are on the line is 260 HP., so that the actual traction of the 61 cars with their load, aside from the friction of the rope and engine, is about 4.01 HP. per car. The net result of 99-100 ct. per car-mile for all engine and fuel expense was given. Under more favorable conditions a better showing is made by a number of roads. One line in the East reports last year 2.28 lbs. of coal used per car-mile, the average load being 4⅔ passengers.

The cost of ropes, with the expense of grip repairs, on the Kansas City road is 1.21 cts. per car-mile. On the short main line a rope lasts six months, and on the independent branch line for two years, the approximate life for the ropes being 20,000, 55,000, 68,000 and 130,000 miles. The cables are bought on a guarantee and the cost charged out each month. These lines could be built to-day for less money than they cost five years ago. The cost of a main line in the East built on a perfectly straight line for very heavy traffic, with a design to secure permanence and small operating expense, having 33,000 ft. of rope driven by compound condensing engines of 300 HP. each, was $239,240 per mile.

In the Census Bulletin (Eng. News, May 23, and Oct. 24, 1891) the cost of ten cable roads was given at prices varying from $160,000 to $684,000 per mile, or an average of $350,000 per mile. But such statistics are misleading; the more usual range of cost should be from $150,000 to $250,000 per mile, with a service not materially less than 1,000 car-miles daily per mile of double track. These figures seem to indicate additional expenses per car-mile of from 2¼ to 4½ cts. To reach conclusions as to the cost of a system it is proper to consider only such as have been built without entanglement with construction companies, or incompetent engineering, and have been run with a reasonable amount of skill and economy. In this, as in all other matters of construction, skillful designing has much to do with success. There has now been enough experience to take the consideration of cable roads as business propositions out of the region of conjecture, and enable the engineer to reasonably forecast their cost, the expense of their operation, and the probable returns.

The second paper read was by J. P. Frizell, on "The Old-Time Water-Wheels of America." He referred to the old millwright as one who made little use of tools and left few records of his work. The sources of information are, therefore, personal recollection, sketches and hints in old books, and records in courts of law. Wooden water-wheels consist of five principal parts: The shaft, the arms, the shrouding, the soling and the floats. The distinction between the overshot, the undershot and the breast wheel consists only in the floats and the mode of applying the water. The construction of the shaft and methods of attaching the arms to it were described for both small and large wheels. The shrouding consisted of segmental pieces attached to the arms, spliced or pinned together at the joints. The soling was the jointed planking attached to the inner edge of the shrouding and forming a tight drum. The floats were the boarding which formed the buckets or paddles of the wheel.

Both the overshot and breast wheels were given a speed above that shown to be most economical. In the undershot wheel the floats were radial, and moved with a velocity of about two-thirds that due to the head of water. These wheels were never geared to more than two pairs or runs of millstones. The velocity of the stones at the circumference was about 1,500 ft. per minute. The bearings of the horizontal shafts were of stone, which were selected so as to be "hard and free from grit." The power was usually transmitted by spur gear. The tub-wheel and flutter-wheel, and their application to an old-fashioned saw-mill, were illustrated and described. The breast wheel began to be replaced by turbines in about 1845. The latest form of the breast wheel was of great length, reaching to over 20 ft. It had four sets of arms and shroudings, the latter at one end bearing the toothed ring which transmitted the power. The water was admitted by horizontal sliding gates. The method of constructing ancient gearing was also described.

AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.—A special meeting was held at Chicago on April 10. About 25 members were present, and 32 new members were elected. The election of a successor to the late H. Stanley Goodwin, President of the Association, was postponed to the October meeting. A communication was received and referred to the Executive Committee asking the Society to take action on the expediency of appointing to positions of responsibility men who belong to secret brotherhoods and may prove partial in their management of men. The chief topic discussed was block signaling practice. Mr. C. H. Platt described methods in use on the New York, New Haven & Hartford, and in the Fourth Ave. tunnel in New York city. Mr. J. C. Wrenne described a block system in use on a 6-mile section of track near Chattanooga, which is used in common by two companies.

AMERICAN RAILWAY ASSOCIATION.—A meeting was held at Chicago, April 12, and in accordance with the recently enacted safety appliance law, the standard height of freight car couplers was fixed at 34½ ins. on an empty car. The maximum variation in height between an empty and a loaded car was fixed at 3 ins. For narrow-gauge lines a standard height of 26 ins. with the same variation was adopted. For hand-holds and grab-irons the standards of the M. C. B. Association were adopted. A progress report was presented by the Committee on Block Signaling, stating that they had heard from 51 roads, of which 15 operate block signals on about 1,700 miles of road. A brief list of definitions of the principal features of the block system and the most important rules covering its operation was presented, but no action was taken upon the report.

The election of officers resulted as follows: President, H. S. Haines; Vice-Presidents, E. B. Thomas, W. F. Merrill; Secretary, W. F. Allen. New members of Executive Committee: Joseph Wood, Lucius Tuttle. President Haines delivered an interesting address on the objects and work of the Association.

ENGINEERS' CLUB OF PHILADELPHIA.—At the regular meeting on April 1, Vice-President James Christie in the chair, 40 members and visitors present, the secretary read a paper by Mr. Pierre Giron, on "The Various Systems of Burning Portland Cement." The author described in detail first the ordinary dome kiln; second, the kiln with dryer and preheater, called the Johnson kiln; third, the Hoffman kiln; fourth, the Dietzsch kiln; and fifth, the rotary kiln; giving the distinctive features of each apparatus, and its method of operation, with the comparative qualities of the product, and concluding with a review of the different patterns, in which the possibilities in favor of the rotary kiln were emphasized at some length. It can now be "successfully operated only in localities where crude oil is abundant and cheap, and it would seem that, in the United States at least, this kiln might become very extensively used. There remains the possibility of replacing crude oil by producer-gas; and when this has been successfully accomplished, there will be no obstacle to the adoption of this admirable form of kiln in the cement districts of Europe."

Mr. R. W. Lesley, in discussion, said that the two main points to be considered in the production of cement are—first, the quality of the product; and, second, the cost of producing it. In Europe rotary kilns have not been successful, and Carey's paper on "Portland Cement," recently read before the English Institution of Civil Engineers, gives the facts as to the throwing out of the rotary kilns in England, in the Gibbs and the Ariesly works. From my information, it would appear that this form of kiln was abandoned not only on account of mechanical defects, but because of the poor quality of the product. The use of rotary kilns in this country for cement-making was begun under the patent of Matte, which was based upon driving granulated cement rock, passed through crushers only, to incipient vitrefaction in rotary kilns. This process was tried on the Hudson and subsequently on the Lehigh, and proved a failure. According to our experience, judged by the product, the particles of cement in going through a rotary kiln are not uniformly burned, and in every case where briquettes have been kept of the cement so made we have found them to disintegrate and dust away at periods of one year and over. For this reason I do not believe in the permanence of cement made in rotary kilns.

With regard to expense, taking the figures of the paper just read, the coke to burn a ton of cement would cost $1.20, while by the new process taking the same figures, the oil would cost about $1.80 for the same amount; as against this 60 cts. difference is to be set the labor of making the raw material in bricks, an inexpensive item. The product of the old kilns by the old process is porous and comparatively easy to grind, while, according to the paper read, the clinker by the new method is harder and more expensive to grind, this being due to the fact that the raw material as it goes to the kiln must be very high in lime, a fact which contributes to the disintegration of the cement at long periods. Therefore, as already stated, I am satisfied that as to quality the new process is not as good as the old, and I think it is yet to be

proved that it is more economical. Referring to Mr. Whitaker's remark that he can clinker small lumps of his rock in a revolving cylinder and make a cement, I would say that there is no doubt that a great deal of the rock in the Lehigh region will make Portland cement, if burned to a clinker just as it is taken out of the quarry, but it is a dangerous thing to do. It is out of such material as this that the cheap Belgian (natural Portland) cements are made, and this accounts for the lack of uniformity in them. The rocks in the Lehigh region are laminated and possibly nine times out of ten would make Portland cement when clinkered, the failures being due to the fact of the mechanical separation of the clinical ingredients in the laminae of the rock. With this possibility of failure, no manufacturer dare trust to using the rock in its natural condition, but must grind it into powder, and make out of it bricks or blocks, where all of the materials hitherto divided in the laminae will be mechanically rearranged and brought into close mechanical union in the "new rock," represented by the brick or blocks, and will thus be in a proper condition for the chemical change that goes on in the kiln.

Mr. Wm. G. Hartranft called attention to the "Shofer" kiln for burning cement, which Mr. Giron has not described. It is a kiln that has recently been commanding the attention of the manufacturers of Portland cement on the continent of Europe. Mr. Chas. M. Saeger, General Manager of the Saylors Portland Cement Works, in company with myself, had the pleasure of thoroughly examining the clinker at the Aalborg cement works in Denmark, where there were eight of these kilns in operation at the time of our visit. The clinker from these kilns was superior to that which we saw taken from the "Hoffman" or the "Dietzsch" kilns in the German mills; in fact, the clinker from these two last named kilns was not as uniform in many cases as that produced by the ordinary dome kiln used in this country. The "Shofer" kiln is somewhat similar to the "Dietzsch" kiln, it being of the continuous vertical type, the main difference being in the mode of firing. In the "Shofer" kiln the coal is fed into twelve cylinders, which encircle the kiln and lead to the crucible, it working on the principle of a self-feeding stove; i. e., when the clinker is drawn from the bottom the coal feeds down of its own accord, along with the cement bricks, which are dumped in through an opening farther up in the kiln, and are partly calcined before they reach the fire, as in the "Dietzsch" kiln. It is claimed by the parties using this kiln that there is a saving of both labor and fuel over the "Dietzsch" process. Referring to the president's remarks about the increase in the consumption of cement in this country, there seems to be still a very large field in this direction. While we were in Sweden we examined large works which turned out girders, building stone and all sorts of ornamental trimmings in cement, and we were informed by some engineers in Copenhagen that this ornamental work in cement cost 50 per cent. less than in clay such as our terra cotta ware. In Denmark and Sweden they use a much larger percentage of sand in cement than is customary in America. This is done by grinding a portion of the cement and sand together until it is very fine (the process is patented in this country, I understand). Experiments have been made with 74 sand to 1 cement, but the average work was about 1 to 11.

The secretary announced that Mr. Giron had alluded to a second paper on "The Grinding of Portland Cement," which would probably be presented at the next meeting.

L. F. Rondinella, Secy.

WESTERN RAILWAY CLUB.—The regular meeting was held at the Rookery Building, Chicago, last week. The "Rules of Interchange" were discussed. The proceedings included a report of coupler tests, the pulling tests being conducted at the World's Columbian Exposition grounds, on Monday, April 17, and the drop tests of the works of the Sargent Co., April 19.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—The regular meeting was held March 21, the president, Mr. M. J. Becker, in the chair, and 52 members present. A paper was read by Mr. Thos. H. Johnson, entitled "A Note on Pin Plates," in which he described some tests of full size top chord members and their modes of failure. The test pieces were duplicates of members for actual use. They were made by four prominent bridge companies, and were in accord with the prevailing practice in the matter of pin plates, and the number of rivets in each. Yet, out of nine tests, seven failed at the ends, and not as columns. Of these seven, five failed by shearing the top flange rivets and buckling the webs in front of the pin plates; one failed by tearing the webs and plates horizontally through the pin holes, as if by vertical strains in the web; and one failed by shearing the top flange rivets on one side, and by tearing the web on the other side, thus presenting both classes of failure in the same piece.

He then showed that the first mode of failure results from insufficient number of rivets to transmit to the top flange its full share of the load, and the second from vertical tension due to the vertical components of the oblique lines of transmission from pin to flange rivets. To correct these evils the following rules are presented:

1, The pin plates should in all cases engage enough flange rivets to transmit to the top angles and cover plate their full proportion of the load.

2, All pin plates should have their fibers vertical and at right angles to those of the web, to better resist the vertical tension.

3, The length of pin plates should be such that the distance from point of pin to farthest flange rivet shall not be less than four times the vertical distance from pin center to top pitch line.

This last rule is provisional only, and is based on the condition that the mean angle of transmission (from pin to middle rivet), shall not exceed 30° from the axis. When the outside pin plate engages flange rivets, those rivets are in double shear—the leg of the angle being held between the pin plates on the outside and the web plate on the inside: and in such cases the third rule will usually govern. For flange rivets in single shear the first rule will require pin plates of greater length than are required by rule three.

At the meeting of the Chemical Section, on March 28, Mr. James Harlow read a paper on, "The Water Supply of the Allegheny River Towns." He gave facts regarding the amounts of sewage now being deposited in the river, and told of many towns engaged in putting in sewers. He showed by analyses that the water had been becoming more impure year by year, and that typhoid fever had correspondingly increased. As remedies, he suggested either an entirely new supply from the mountains, or the filtering of the river water.

Mr. Jas. O. Handy gave the results of many analyses of water of the Pittsburg vicinity. Remarks on "Water Supply" were made by Prof. F. C. Phillips, Dr. Le Moyne, Mr. A. F. McKenna, Mr. Reuben Miller, Dr. Thomas, Mayor Wm. Kennedy, Col. T. P. Roberts, Dr. Daly, Mr. F. L. Aschman, Mr. Jos. Abel and Alex. Dempster.

On motion of Mr. R. N. Clark, a committee of the whole was organized, consisting of three members of the Pittsburg Chamber of Commerce, Mayor Kennedy, of Allegheny, five physicians, five engineers and five chemists. The work of the committee is to investigate and suggest improvements in water supply of Pittsburg and Allegheny.

ASSOCIATION OF CIVIL ENGINEERS OF CORNELL UNIVERSITY.—The fourth lecture at Ithaca was delivered April 14 by Mr. Geo. S. Morison, of Chicago. The subject was "Deep Foundations," in which the lecturer brought up the chief points of difficulty found in such construction on Western rivers. Views were shown of the Memphis and other bridges, and, in conclusion, the lecturer gave some sound advice to the younger members. The next lecture will be presented by Mr. James Owen on "Roads."

NEW ENGLAND RAILROAD CLUB.—At the meeting on April 12 the subject discussed was experience in steam heating of passenger trains during the past winter. The Boston & Albany uses a direct steam system, and is well satisfied with it. It gives much less trouble than was formerly experienced with Baker heaters. It may be a little more expensive, but the managers of the road could not be induced to go back to the old system of heating. There were probably not half a dozen cases of frozen pipes on the road all winter, whereas with the Baker heaters a half dozen cars were in the shop all the time for repairs to heater pipes. The greatest defect of the system is irregularity of the temperature, but this is largely due to the carelessness of the trainmen. On the Old Colony, steam heating has been very successful, during the past winter. Mr. Lauder prefers the direct steam; most of his cars are in service on short runs, and he has arranged stationary plants which supply steam to the cars while standing and keep them warm over night. This was rather an expensive task, as there are 41 places on the system where cars are laid up over night. Uniformity is important if good results are to be secured. Trainmen familiar with one system of heating will make mistakes in handling another and different one, and unevenly heated cars and frozen pipes are the result. On the Old Colony the only troubles from frozen pipes during the past winter were on cars from other roads.

The Fitchburg R. R. uses one of the Consolidated Car Heating Co.'s direct steam systems of heating, and the cost for extra help to take care of the steam heating plant is less than what it was when there were stoves in the cars. There has been no trouble from frozen pipes, and the heat is regulated fairly well. With direct steam Mr. Marden prefers to let the cars cool off over night. A car will heat up in 15 or 20 minutes after steam is turned on.

Mr. E. W. Grieves, of the Baltimore & Ohio, said steam heating on the B. & O. had been fairly successful. The difficulties had been in educating the trainmen to properly care for the steam heat. There was also some trouble on account of the number of different systems, eight being in use on the B. & O. lines. He had not yet been able, however, to decide which system was on the whole preferable. Pressure carried on the locomotive in steam heating is usually 20 to 30 lbs.; but extremes of 15 to 50 lbs. are sometimes reached.

Mr. Lauder referred to Prof. Lanza's experiments as to the amount of steam required for steam heating made some years ago, which showed a consumption of about 80 lbs. of steam per car per hour with the temperature outside a little below freezing. He thought this was quite a drain on a poor steaming locomotive. He thought steam heating was more expensive than other methods. He had tried automatic thermostats, but for short runs they are of no use, as they do not let in steam enough at the start to warm up the car rapidly. For long runs they are an excellent thing.

Mr. Robert M. Dixon said a rough but good rule in direct steam heating was to allow a drop of 5 lbs. in pressure for each car in the train. He favored direct steam for short runs and suburban service with some arrangement for varying the heating surface by cutting out part of it in mild weather. With hot water systems, however, the pressure in the steam pipe may be less even than atmospheric if desired.

At the next meeting, on May 10, "Standard Trucks and Foundation Brake Rigging" and "Amendments to the Interchange Rules" will be the subjects for discussion.

ENGINEERS' CLUB OF CLEVELAND.—The regular meeting was held April 11, President Porter in the chair, and 50 members and visitors present. Mr. C. F. Uebelacker read a paper on "Electric Railways," and the following calendar was arranged: May 9, Architecture; June 13, Railway Engineering; July 11, Electrical Engineering; August 8, Civil Engineering and Surveying; Sept. 12, Mechanical Engineering; Oct. 10, Applied Science; Nov. 14, Marine and Steam Engineering; Dec. 12, Hydraulic and Sanitary Engineering. 1894: Jan. 9, Electrical Engineering; Feb. 13, Civil Engineering and Surveying; March 13, annual meeting; April 10, Applied Science.

COMING TECHNICAL MEETINGS.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 20, Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.
DENVER SOCIETY OF CIVIL ENGINEERS.
April 25, Secy., F. E. King, Jacobson Block.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
April 26, Informal meeting. Secy., L. V. Carmalt, Roanoke, Va.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
April 28, Secy., A. H. McLeod, Montreal P. Q.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
May 1, Secy., A. L. Annis, In Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
May 2, Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
May 3, Secy., Jno. W. Weston, 51 Lake side Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 3, Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
May 3, Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF MINNEAPOLIS.
May 4, Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
May 5, Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
May 5, Secy., O. Von Geldern, 719 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
May 6, Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
ENGINEERS' CLUB OF PHILADELPHIA.
May 6, 1122 Girard St. Secy., L. F. Rondinella.
WISCONSIN POLYTECHNIC SOCIETY.
May 8, Secy., M. F. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY.
May 8, Secy., Waterman Stone, Baird Building.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
May 9, S. W. Spear, E. Buffalo, N. Y., Iron Works.
NORTHWESTERN SOCIETY OF ENGINEERS.
May 9, Secy., D. W. McMorris, Burke Block, Seattle, Wash.
NORTHWEST RAILROAD CLUB.
May 9, Ryan Hotel, St. Paul. Secy., W. D. Crosman.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
May 9, Secy., F. C. Osborn, Case Library Bldg.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
May 10, Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
May 10, Secy., F. M. Curtis, O. C. R. R., Boston.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
May 11, Secy., F. W. Mowbray, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
May 11, Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
May 12, Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
May 13, Secy., F. D. Jones, Helena.
COLUMBIAN ENGINEERING SOCIETY.
May 16, Secy., F. W. Hart, Washington, D. C.
WESTERN RAILWAY CLUB.
May 16, Secy., C. F. Street, Rookery Building, Chicago.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 16, Secy., R. H. Clark, Pittsburg.
BOSTON SOCIETY OF CIVIL ENGINEERS.
May 17, Secy., S. E. Tinkham, 36 Broomfield St.
NEW YORK RAILROAD CLUB.
May 18, Secy., H. G. Prout, 73 Broadway, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
May 18, Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
May 18, Secy., C. F. Franson, Portland Block.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
May 19, 201 Washington Building.
CENTRAL RAILWAY CLUB.
May 24, Secy., S. W. Spear, Buffalo, N. Y.
AMERICAN RAILWAY MASTER MECHANICS ASSOCN.
June 19, Lakewood, N. Y. Secy., Angus Sinclair, New York.

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AND

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The refusal of Judge Pratt to affirm the award of the commissioners for the property of the Long Island Water Supply Company, of Brooklyn, noted at length in another column, on the ground that some $200,000 is not a sufficient allowance for the value of the company's franchise, brings to mind the fact that the Massachusetts Legislature last year laid down the principle (Eng. News, March 12, 1892) that franchises granted to water companies without compensation to the municipality should not be paid for by the latter in case the city subsequently bought the company's works. This principle was based on the assumption that what a city gives to a water company in the way of privileges it should not be compelled to buy back in order to regain possession. In the Brooklyn case, the commissioners were obliged to put a valuation on the franchise, under the legislative act or acts which they were carrying out, but they concluded the franchise was not exclusive and valued it accordingly.

Whatever may be the merits of the present case we believe that the time is coming when franchises will be granted on such a basis that a city will not have to pay for the repossession of a right which it has allowed a private company to exercise in its stead for profit. The town of Methuen, Mass., it may be added, has just bought out the franchise and other property of a local water company at actual cost, plus interest on the investment, as provided for in the legislative act chartering the company.

Some of the Chicago papers are congratulating themselves and their readers over the conclusions of the representatives of the London "Lancet," noted briefly in our issue of April 6, that the water furnished in Chicago "from Lake Michigan is good throughout and, provided it is efficiently filtered and boiled, there is no chemical objection to its use." If the city of Chicago had facilities, and utilized them, for either filtering or boiling its water supply then the people of Chicago might find comfort in the above quotation. But the city possesses no such facilities, and since only a comparatively few individual householders, business and industrial establishments will either filter or boil water used for drinking purposes, it follows that if the water needs one or the other of these processes the city is in danger. It must be remembered that most English cities filter their public water supplies before delivery to consumers, and that London, where the "Lancet" is published, has a water supply which is either carefully filtered or drawn from deep wells supposed to be beyond contamination, so that when filtration is spoken of, as quoted, it is fair to assume that central filtration and not individual filters for each household is meant.

In the same mail with the news of the congratulations over the London report indulged in by the Chicago papers comes the notice of the incorporation of a domestic filter company at Rochester which proposes, not to sell, but to rent domestic filters at $1 per month, or $12 per year. How such rates would increase the cost of water to thousands of the poorer classes in Chicago, practically putting filtration out of their reach, is plainly evident.

As to boiling the water, which is certainly a possible treatment for all, it only needs to be stated that if boiled the water would need to be cooled with ice and the "Lancet" commissioners threw discredit, whether just or unjust, upon the quality of the Chicago ice, and insisted that ice should be placed around and not in the water to be cooled, which trouble great numbers of the people of Chicago or any other city would not take. In addition many people could not afford ice, and during hot weather would not drink water which had been boiled but not artificially cooled, which renders boiling still more impracticable and much less likely of general adoption.

The paper on the use of paint as a preservative of structural ironwork, abstracted elsewhere in this issue, is worthy of attention as an unusually interesting contribution upon a subject which has been but little treated of in technical literature. In structures of the character discussed, the principal requisite of a paint is to preserve the metal from the action of the elements, and especially from destructive gases; the esthetic considerations of tint, luster, etc., being of a very minor importance. Moreover, the characteristics which make a paint a good preservative of wood not only may be, but are very likely to be, those most to be avoided in paints for ironwork. The natural elements probably cut a very small figure in the deterioration of ironwork unaccompanied by gases of manufacture, since their action may be fairly well provided against, although even here the absorbent power of the linoxin, if Dr. Dudley's experiments be true, is a source of danger. But the atmosphere is seldom free from corrosive gases in localities where such structures must be located. The corrosive action of the gases of combustion from locomotives is one of the greatest annoyances with which railway engineers have to deal, and nothing in the shape of a paint has yet been brought forward which will more than temporarily delay this action—a sad comment on the apathy or inventive faculties of our chemists, considering the financial possibilities of such a material. Possibly the "anti-rust" paint mentioned by Mr. Brown may be the solution, and of this we may say more later. At the same time, many engineers neglect to adopt the simple precautions necessary to secure the best results from paints in common use. To be sure, the specifications for structural ironwork usually contain provisions as to painting, but these are couched in such general terms as to be practically worthless. Again, an inferior paint is specified to save a few dollars in first cost—an economy which seems the more absurd since it is obvious that the cost of material is but a small part of the total cost of painting. Considering the minute attention paid to the qualities of structural iron and steel, this neglect in securing a good protective paint upon which the life of the structure largely depends is decidedly illogical, to say the least.

Trade advertisements in the proceedings of technical societies are commented on as follows by our English contemporary, "Industries":

> We never know quite how far the straightforward system of advertisement adopted in America is to be commended or condemned. For instance, we have just received a copy of a paper read before the American Institute of Electrical Engineers on "Micanite." It is a trade prospectus pure and simple, and is followed by a discussion. Recently, again, there was a paper on the Thomson joulemeter or watt-meter, as it is termed in the United States. In this country we have trade circulars, too; but we frequently "assume a virtue when we have it not," and disguise the circular under a thin veil before bringing it before a scientific or technical society. When an English firm desires to push a new insulating material, made, say, of mica and cement, or a meter which is devoid of any scientific originality whatever, one of its members reads a paper on "The Dielectric Properties of the Earthy Silicates," or, "Electrodynamical Means of Integrating Electrical Power," and their goods are thus advertised successfully. The American method is at least more straightforward, though, perhaps less dignified.

We can best answer our contemporary's fling at the Thomson electrical meter by quoting from a recent paper on "Electrical Measuring Instruments," read before the Institution of Civil Engineers by an English electrician of high rank, and abstracted in our issues of Sept. 15 and 22, 1892. The author, Mr. James Swinburne, after severely criticising nearly every form of meter ever invented, said of the Thomson meter: "This meter seems to be almost perfect." It will also be remembered that Professor Thomson received the prize of 5,000 francs offered by the City of Paris to the inventor of the best electric meter.

As for the broad question of the propriety of admitting what our contemporary calls "trade" matter into the proceedings of technical societies, there is considerable to be said on both sides. The prejudice is widespread, undoubtedly, against the admission of such matter, and is probably stronger in England than in this country, which may explain the circumlocution to which our contemporary refers. On the other hand, the papers and discussions which contain more or less of "trade" matter include the most important and practically valuable portions of technical society proceedings. As an extreme example, Sir Henry Bessemer's first public description of his steel making process was given in a paper read before the British Association for the Advancement of Science, and the immediate results of the reading of that paper was the granting of licenses by the inventor, amounting to over $125,000 within a month after the reading of the paper.

The criterion by which the admission of papers before a technical society should be decided is: Is this paper and the discussion which it is likely to bring out of sufficient interest and value to the members to justify the appropriation of their time to listen to it and their money for its printing and publication? It is certainly no argument against the admission of a paper that its author will thereby advertise himself and his work. Is it a more valid argument against a paper which meets the condition named above that some firm or company has its products or devices advertised thereby? It must be remembered that in a properly conducted technical society, "trade" matter has to stand on quite a different footing to gain admission from that which is required in a firm's own publications, or even in the average run of technical journals. The man who describes some machine, process or product in a paper before a technical society has first to run the gauntlet of the "publication committee," not always so difficult as it should be, it is true. If successful here, his statements when presented are subject to the criticism and contradiction of any member of the society, frequently of his competitors themselves. Any misstatements, overpraise, unfairness or other defect is liable to be, and always ought to be, clearly pointed out. These things combined tend to exclude from the proceedings of the leading societies trade matter which is not worthy of a place by means of its intrinsic importance and value.

It must be admitted, of course, that despite these safeguards, some few papers do creep into technical society publications which are open to objection. There is some tendency to describe new devices when they are in an immature stage and experiments which are too fragmentary to be of much practical worth. We would say nothing to encourage this practice.

On the other hand, there are men who hesitate to present the results of extensive investigations, or descriptions of valuable and important new inventions or processes before a technical society for fear they may be thought to be "blowing their own horn," or giving a puff to some firm or company or its products. The paragraph from our contemporary above quoted seems well calculated to encourage this false impression, and deserves criticism on that account.

The Director of Public Works of Philadelphia, Mr. James H. Windrim, evidently means to keep cholera out of that city during the coming summer

if cleaner streets and backyards can do it. We have already noted his action in causing the cobble-stone pavements of the narrow streets and alleys, in the slums of Philadelphia, to be replaced with asphalt pavement, that can be kept reasonably clean. He is now after the street cleaning and garbage removing contractors, and has just fined one of them nearly $5,000 for neglect of duty in this particular. He has imposed a fine of $5 for every well-founded complaint from a householder that his garbage has not been removed at the proper time and in the proper manner; and he notifies contractors that he will raise this fine, on a sliding scale of $5 for each raise, until complaints cease. The women of Philadelphia have also enlisted for the war and are preparing to make the lot of both contractors and policemen an unhappy one. A branch of the Women's National Health Protection Association has sent out missionaries to work upon housekeepers, and a bureau has been established for the reception of complaints against street cleaners, garbage collectors and police. A committee of energetic women will see that these complaints are promptly attended to, and the association has published and widely distributed a list of the nuisances prohibited by ordinances. Secret complaints against unclean neighbors are also invited and these will be investigated by agents of the association.

Unfortunately, the medicine of Dr. Windrim cannot be administered in the same manner to those responsible for the cleanliness of the city of New York; but something of the spirit that actuates the Philadelphia Director of Public Works would be most welcome in our own officials. They have the same, or even greater authority, and certainly spend money enough to accomplish much more satisfactory results than are now evident. The authorities of every large city have a heavy responsibility resting upon them, in view of the threatened visitation of cholera; but it is the city of New York that will be reached first, if it does come, and it is in the slums of this city that cholera will find the material most suitable for its development and growth. Philadelphia has set the example of first guarding against the entry of the scourge into the slums by rigid house inspection and by providing a pavement that can be kept clean against the accumulation of filth in the streets. This action, coupled with the evident energetic work proposed in the prompt removal of all refuse matter, indicates a sense of public responsibility on the part of the officials of Philadelphia that is worthy of emulation. We wish we could see more evidence of a similar obligation on the part of our own city authorities.

THE LONG ISLAND WATER SUPPLY CO. CASE.

The refusal of Judge Pratt, of the Supreme Court, to affirm the award of the commission appointed to fix the value of the property of the Long Island Water Supply Co. is a surprise to the citizens of Brooklyn. This now famous—or infamous—case, as different people regard it, must go to a new commission, and the whole evidence be gone over again from the beginning. The late commission awarded the sum of $570,000 as full compensation for the present value of the property, plant and franchise, in which some $200,000 represented the value to-day of the franchise rights of the water company, which, under its charter, had a monopoly of the right to furnish water to the town of New Lots, now the Twenty-sixth Ward of Brooklyn, until 1931. As most people know, the controversy arises from the annexation to Brooklyn of this town of New Lots, and the enforced purchase by the city of the property and rights of a private water company. The case turns on the very important and interesting question of the value of the franchise, both parties practically agreeing as to the value of the property and plant.

Judge Pratt bases his decision upon "a cold question of law," and at great length argues that the company has a legal right to a monopoly of water supply until the year named; that this right is its chief property, and that it should be properly compensated when this right is taken from it by the city of Brooklyn. In other words, he claims that the sum awarded by the commission is not sufficient to represent the value of this franchise, once fixed by the Brooklyn authorities, under somewhat peculiar circumstances, at $1,250,000, and he refuses to confirm.

This is the gist of his argument, and is sound as far as it goes; but there are some other points, that are of widespread interest and importance in the de- of widespread interest and importance in the de- sion of similar cases, that he does not touch upon. A legal franchise to supply water to a rapidly-growing community for a long period is undoubtedly of very considerable value, and its owners should be fully compensated for this right when it actually exists in the proper meaning of that term. But the right to supply water implies a sufficient and acceptable supply of good, wholesome water, unpolluted and above reproach; to furnish any other than water meeting these conditions carries with it the common right to refuse the supply offered, and the payment for water, and the whole value of the franchise disappears. In this case the Long Island Water Supply Co. was shown to obtain its water for present consumption from a well and tubes sunk into the water-bearing sand stratum underlying the site of a part of the Twenty-sixth Ward. The water-bearing area at its disposal is limited by the proximity of tide-water and two pumping stations of the city of Brooklyn, one of which is drawing water from an area immediately to the east of the company's works, and the other to the north having tubes already sunk into the sand, and having the right and the means to pump at any time occasion demands.

But more important in its bearing than this limited supply area is the fact that the rapid growth of the ward, upon which the whole value of the franchise is based by the company's attorneys, means the building up, paving and sewerage of the area contiguous to the company's well; the consequent reduction in the amount of rainfall entering the sand; and the pollution of the amount that does enter. The present limited demand for water is met, in a somewhat unsatisfactory manner, by a daily consumption that does not carry with it any dividends to the owners of the franchise. But long before the expiration of the period of the monopoly, the evidence and the experience in other cities shows that the water company must not only abandon its present source of supply, but it must go many miles to the eastward to avoid the contamination and the draft upon the underground water of the continuous line of towns and villages that even now represents a large population beyond this new ward. There is a great difference between obtaining 1,000,000 gallons per day and 16,000,000 gallons for the same period and under widely differing conditions in 1931, and it seems to us that before the value of this franchise can be fixed it remains for the company to show, in some satisfactory manner, that they can furnish the quantity and kind of water implied in their charter for the period over which they claim a monopoly. The burden of the proof rests upon them; for they must show that they have a tangible something to sell before they can properly fix upon and demand a price for this right. The company's evidence does not touch upon this at all, except in the most vague manner; and their whole case, as well as the late decision of Judge Pratt, rests upon the assumption that they have all the water needed to fulfill the conditions of the case. No private capital could be enlisted on the case as it stands in the evidence before the late commission, and there is no good reason why the taxpayers of Brooklyn should be regarded as other than private investors in this franchise; private capital must pay for it in any event.

With the exact amount of $570,000, as fixed by the late commission, we have nothing to do; it may be too little or too much. But in the interest of engineers and the owners of franchise rights everywhere, we trust that the next commission will deal less with "the cold question of law," based upon an unproved assumption, and pay more attention to finding out as exactly as they can the true value of the rights which they are called upon to buy. They are supposed to pay for the extinguishment of a right to furnish an abundant supply of wholesome water. If water of this description cannot be furnished for any considerable part of the next thirty-eight years, or for the next ten years, the value of the franchise is decreased by just that amount. It is for the water company to prove that it would have the water to sell until 1931, if it was left undisturbed in their rights. This it has not done.

In the three French engineering schools, or "Colleges des Arts et Metiers," the discipline approaches that of West Point, and the work of the student is exceedingly hard. Work begins at 5:30 a. m. and ends at 9 p. m., with 1½ hours for meals and an hour for recreation. No holiday occurs in the week, and only an extra hour or two recreation on Sunday. Most of the time, however, is spent in the workshop and at the drawing board, so the strain on the student's health is not so great as might be supposed.

The canals on Mars, says Dr. A. Tooska, in "Die Natur," are simply rifts in the crust of that planet, due to collisions with one-time satellites. To support this theory he says that one of the present satellites of Mars, "Phoebus," revolves around that planet at a distance of only 806 miles, and is within the limit where the attraction of gravitation is in equilibrium with the centrifugal force. It is approaching Mars at an ever accelerating rate, and in a few decades, perhaps, it may strike the planet at a lower angle, and running along its surface, make another "canal." It would form two parallel elevated crests, which after cooling will be covered with snow and ice. Under the great heat of contact ice would be melted, and the furrow filled with water. This water would again freeze and present the bright line, relieved by the shadows of the high mountains, familiar to observers. Mars, in its eccentric orbit, passes through the orbits of numerous other planetoid bodies, and may have had frequent collisions with them.

A journey of 1,800 miles on snow-shoes has been made by a Mr. C. H. Hamilton, an employee of the Yukon River Transportation & Trading Co. He was frozen in with a steamer of the company two weeks' journey above the mouth of the Yukon, and was sent to carry the news to his company at Seattle. He started on Nov. 23 with three sleds, 21 dogs and some Indian guides, and arrived at Chilkoot, 80 miles above Juneau, on March 20, after an 1,800-mile trip.

The Massachusetts Legislature has passed an act authorizing county commissioners, when called upon, to examine dams thought to be unsafe, to employ a competent engineer to make the examination and report upon the same in writing.

The concession to the Panama Canal Co. has been extended for 20 months, or to Oct. 31, 1894, by the Republic of Colombia. This time is granted for the organization of a new canal company. If that is possible, 10 years will be allowed for the completion of the canal. The official liquidator of the canal is required to pay to Colombia 500,000 frs. which is to be deducted from 8,000,000 frs. payable by the new company, when formed. The plant is to remain under the control of the Colombian government.

A dive with armor to a depth of 196 ft. is reported as having been safely made by Capt. John Christiansen, at Elliot's Bay, Wash., on April 9. He was under water for 20 minutes, and apparently suffered no serious inconvenience.

The cost of discovering America by Columbus, says Prof. Ruge, in the "Globus," was 1,140,000 maravedis; or about $7,296 of our money. The money of Queen Isabella, of course, had a higher purchasing power than the dollar of to-day. Of the sum named, Columbus received an annual salary of $320, and the two captains, each $192 per year. Each sailor, in addition to his subsistence, received $2.45 per month, or one ducat.

The New York State forestry bill, signed by Gov. Flower, creates a new Board of Forest Commissioners of five members, without salary. The real purpose of the bill, however, is to co-operate with owners of private land who offer to add 500,000 acres of wooded territory to the 500,000 acres owned by the state in the proposed Adirondack Forest Preserve, under certain conditions. Under the bill this land is to be exempt from state taxes, and no trees under 12 ins. in diameter 3 ft. above the ground, are to be cut down. The state may sell about 250,000 acres now owned by it, and laying outside the line of the proposed preserve; and the commissiorers may exchange this land for property inside the lines laid down, or they may sell "ripe timber" inside the preserves and use the proceeds in purchasing other land.

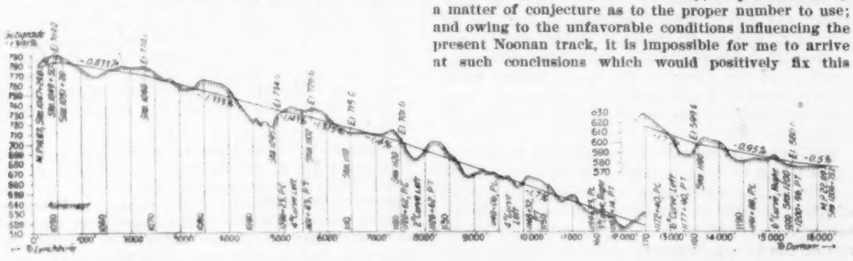
An expedition to reach the north magnetic pole is planned by Mr. W. H. Gilder. The instruments and observers would be furnished by the U. S. Coast and Geodetic Survey; but about $25,000 must be raised by private subscription to defray the cost of transportation and subsistence, for which no government appropriation is available. The purpose of the expedition would be to increase our knowledge of terrestrial magnetism, set at rest the question of the movement of the magnetic poles of the earth, and definitely ascertain this movement, if it exists.

LETTERS TO THE EDITOR.

THE NOONAN CONTINUOUS TRACK.

Sir: In further reference to the Noonan or continuous track discussion (Eng. News, Jan. 12, Feb. 2 and Feb. 23, 1893) I desire to add a few words to this already much discussed subject, as I entirely disagree with Mr. Churchill in the conclusions which he reaches in regard to the feasibility of continuous rails, and which conclusions he deduces from the statements made by me to him, pertaining to the present condition of the Noonan track. This statement of mine was merely a presentation of actual facts as they now exist in a particular instance, and it was not my intention that this statement should in any manner whatever be construed as an argument for or against the use of continuous rails on standard railways, for, as I have already stated, my conclusions are directly in opposition to those formulated by Mr. Churchill. So far as the present condition of this track is concerned, to my mind at least, instead of condemning the use or feasibility of continuous rails, it forcibly brings to view those things which should be particularly avoided in the construction or application of continuous rails to standard railway track.

A few weeks after my official connection with the Noonan track (March, 1892), I made a thorough exam-



PROFILE OF NOONAN CONTINUOUS TRACK: NORFOLK & WESTERN R. R.

ination of the physical condition of the same in company with Section Foreman Noonan, the inventor and layer of the Noonan track. When we arrived at the end of our inspection of this piece of the road, I summed up what we had seen, as follows:

First, This track was laid on a new roadbed without ballast of any kind, and was also buried to the top of rail with the same material, i. e., the earth composing the roadbed.

Second, The track was out of line and surface at certain places.

Third. The rails were riveted together with ordinary four-hole fish plates and ¾-in. rivets.

Fourth. A great many of the rivets were broken and out.

Fifth, One set of switch points, for expansion purposes, was situated at either end of this stretch of track, or about three miles apart.

During the year just passed the line and surface gave us a great deal of trouble, and considerable money has been spent in the improvement of the same. The ties have decayed much more rapidly than they should have done under other conditions. In order to become familiar with all the conditions affecting this track, I must submit the accompanying profile which graphically shows at a glance certain features pertaining to the location and the construction of the track, and which I have also shown by the following figures:

1. Total length of the Noonan track, 3.02 miles, or 15,945.6 ft.

2. Of this track 8,637 ft., or 54.17%, is laid in cuts, and 7,308 ft., or 45.83% on fills.

3. Of this track, 12,350 ft., or 77.45%, is on tangents, and 3,595 ft., or 22.55%, on curves.

4. Of the track on curves:
   16.7% is on a 2° curve.
   10.9% " 3° "
   31.9% " 4° "
   40.5% " 6° "

Of the track on curves: 1,656 ft., or 46.1% is laid in cuts, and 1,939 ft., or 53.9%, on fills.

6. All but 180 ft. of the total length of track is on a grade, the total difference in elevation being 208 ft.

It can readily be seen, from some of the conditions quoted in the foregoing statement, what influences were brought to bear upon the line and surface by the lack of ballast, sinking fills and unstable track, the weight of rail being 56 lbs. per yd. My conclusions and deductions, therefore, as to whether continuous rails are feasible can then be stated as follows: Judging from facts obtained by the observation of the Noonan track, I am of the opinion that continuous rails for standard railways are feasible, and, furthermore, that this type of track is the most desirable end to be reached in future railway maintenance, financially considered, and as a matter of comfort to persons while traveling. As I view it, however, the following conditions must govern the construction of this kind of track in order to fully justify the above opinion:

1. The Noonan or continuous rail track should never be laid on a new roadbed, or a roadbed which has not been in use a sufficient length of time to insure it against settlement, or, in other words, it should not be laid on a roadbed which has been in use less than ten years.

2. This track should be laid on a bed of good broken stone or other suitable ballast, and should never be laid when a good ballast of some kind is not obtainable.

3. I agree with Mr. Gleaves that metal ties should be used with the continuous rails.

4. If wood ties are used, they should be of oak, and the rails should be laid on tie plates or, preferably, suitable chairs, placed on every tie, to prevent the possibility of the rails overturning, and to assist the travel or expansion of the rails.

5. The expansion switch points should number at least two sets per mile, or even three where the alinement is very much broken. These points should be placed, if possible, at the beginning or end of curves, but should not be placed on curves unless absolutely unavoidable on account of the alinement. It is well to state here that this question of expansion switch points, which I consider one of the most important factors in this whole matter, is, unfortunately, at present merely a matter of conjecture as to the proper number to use; and owing to the unfavorable conditions influencing the present Noonan track, it is impossible for me to arrive at such conclusions which would positively fix this matter. However, after sifting the good from the bad, there remains, I think, sufficient evidence which favors the possibility, the feasibility and the probability of the use of continuous rails on standard railways, as herein set forth.

6. Suitable plates, which exactly conform to the shape of rail, and having the proper size of holes for rivets, should be used instead of angle bars.

7. A heavy rail is preferable; this fact, of course, being self-evident.

Yours truly,
Theo. Low.
Supt. Durham Div., N. & W. R. R.
Lynchburg, Va., March 20.

CONDUIT SYSTEM OF ELECTRIC RAILWAY.

Sir: In your issue of April 6 you spoke of the Wheless system of underground trolley, which is being tried on a 3-mile section of the Washington & Arlington Ry. I would like to occupy a little of your space in a partial description of the Love underground trolley system, which the Rock Creek Ry. Co., of the District of Columbia, has just finished building on its line, which lies within the city limits. The line, as constructed, is 1¼ miles in length, double track, having three curves of 65 ft. radius and grades varying from 1% to 4%, the latter being for 200 ft. only, but including one of the curves.

The construction is similar to that of a cable road except that the conduit is 18 ins. deep and the slot rails extend down farther, so as to allow the wires, of which there are two, one on the inside of each slot rail, greater protection. The sides of the conduit are iron plates, and the bottom is 4 ins. of concrete. The yokes were spaced 4 ft. 6 ins. c. to c., and weighed 260 lbs. each, and were set in 6 ins. of Portland cement concrete; U rails were used, weighing 62 lbs. per yd. The slot rails weighed 42½ lbs. per yd. Two pressed mica insulators were keyed to every other yoke, and were clamped onto the wire, which was No. 0000, and grooved, so presenting a smooth surface for the trolley. Manholes were constructed every 100 ft. and drained to the sewer. At Fourteenth St. a crossing of the Washington & Georgetown Ry. Co.'s cable was built.

The trolley consists of an iron hanger and block with two trolley arms and wheels, the latter being held up against the lower side of the wires by self-adjusting springs. Our temporary power-house, where we have a 150-HP. boiler and engine and a 500-volt M. P. generator, giving a current of 180 amperes, is situated 1,700 ft. from our line, from which we run feed wires. A car (one with Robinson's radial trucks, 33 ft. over all) has been running over the first half mile of the line for a month without a hitch, and on Saturday the complete trip was made successfully. The system is run open, the circuit being made through the car and motor; a very perceptible gain is realized in this metallic circuit, as snow or debris on the tracks have no effect on our return current, as it would on the systems using the rail return.

It takes about 10 amperes to run our large cars loaded at a speed of about 15 miles per hour. Another convenience of this system is that the slot rails are so fastened to the yokes that they may be unbolted and taken out at any time without disturbing the paving, and so rendering easy access to the conduit. The company contemplates trying the present line for a month, and, if nothing impracticable develops, to continue the road through the city.

I am yours very truly,
T. R. Hinsdale,
Chief Engineer Rock Creek Ry. Co.
Washington, D. C., April 10,

(The Love conduit system, as applied at Chicago and Washington, was described in our issues of March 19, April 16 and Dec. 29, 1892.—Ed.)

"ENGLISH AS SHE IS WROTE."

Sir: Adressing on your adresse by separate envelope and the same mail, letter-patent-copy and drawing of an Injector. whose consumption and repute on account of its practical improvements is growing more and more and upon that, I beg to follow any other particulars, namely: 1) Simpleness: The valve introducing steam, not tis to subjoin on the Injector direct, rather can be annexed on some other seat.

(2) Stable working: The valve protects the Injector to be warmed so prejudicially.

3) Much spearing of expenses; because every mechanism for shutting out or into passing by said valve is avoided, therfore is no entering of any repair-costs.

As also the Injector has been in use and good proofs are done therewith, for it they write:

The Koenigliche Hauptwerkstatt of the Direction-bezirkes, Berlin, by letter of 24th August.

"Your said steam valve has been verified good hitherto, the handling of the valve is more simple, than those of the former constructions. Repairs have not arrived further, we are able of informing you, the state of the valve for steam passing in and which was fixed on the locomotive No. 1107 since 2d October 1891 is til now been finding good and no any repaire has arrived."

Also, The Koebsnigliche Eisenbahn Betrichs Amt Stadt of "Ringbahn, Berlin, from letter by 17th August 1892, Journal No CI 7709".

"For reply to your letter of 1st Aug., we have to state, that the transmitted valve is been finding very good and no any interruptions are to be noted."

Thinking that this invention, which is privileged by patent in America 472,949 might have sufficient interest to your lectors, I am induced to take the liberty if you should not be so kind enough, as make some description of this invention in your gazette, when gratis. In return of it, I intend to order announcements by short time. By the patentee I am empowered to sell the patent and in case somebody would have interest, it is I, they would learn the conditions. Cliches are also to your disposition. In expect of you very kind answer, believe me, Dear Sir, yours very truly,

H.— S.——, Patent-Agent.
Berlin, 3, March, 1893.

(If any of our readers are amused at the language of the above communication, which we print verbatim, let them reflect what a spectacle they would make if they attempted to wrestle with the nine-storied words which the German engineer rolls under his tongue as sweet morsels. Notwithstanding the pitfalls which the English language contains, as evidenced by the above letter, we must still believe that they are as nothing to the mountains which loom up in every paragraph of the German.—Ed.)

TESTS OF OREGON OR DOUGLAS FIR TIMBER.

Sir: In your article on "The Present Status of Timber Tests," I read that no tests of Oregon or Douglas fir have yet been received. I would like to call attention to some tests made of this wood from the state of Washington by Mr. Geo. S. Morison, at the Pittsburg Testing Laboratory, in 1886, the results of which, in detail, I have by me.

The coefficients of ultimate strength per sq. in., as shown by the average of the tests, are as follows:

	No. of tests.	Compression.	No. of tests.	Tension.	No. of tests.	Transverse strength.
Red fir..	2	6,099	4	10,872	11	883
Yellow " ..	2	6,132	5	11,550	9	835

The transverse tests were made between two supports, each 2 ins. wide, and 30-in. centers. The weights were applied at the center on a plate 3 ins. square, and the length used in calculating was 15 ins. Calling the length of the beam between edges 12½ ins., the coefficient of transverse strength would be reduced to

736 and 697 lbs., respectively. It is not stated whether the wood tested was seasoned or not, but it is safe to assume that it was, at least, fairly seasoned.

There is in Oregon a distinction between red and yellow fir lumber, and they may be from different kinds of trees; but I have never been able to find anyone there who could tell the difference between them when standing in the forest. The white fir is quite distinct, and I believe both are the Douglas fir. There is a general belief on the Pacific coast that this fir is stronger and better for bridge timber than the white pine of Michigan and Maine. This would seem to be borne out as regards transverse strength when the results are compared with those given for pine in Trautwine's tables:

I believe that new tests are to be made soon at the Government Experiment Station, at the Oregon Agricultural College, at Corvalles, Ore.

Yours very truly,

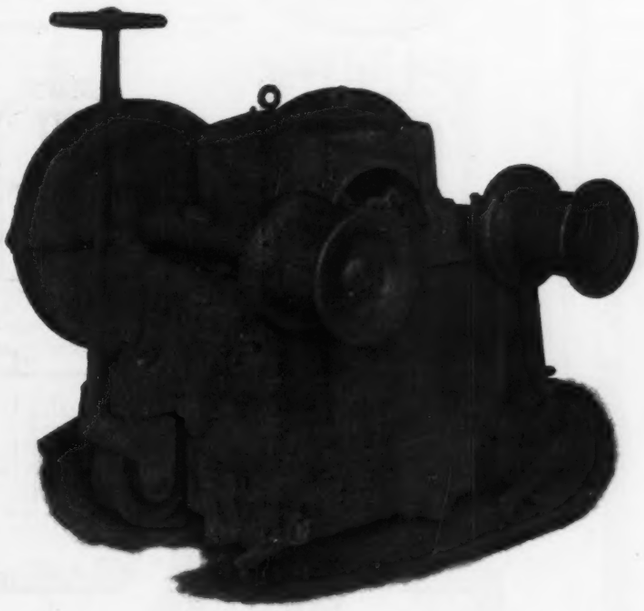
W. B. Wright,

Div. Engr., M., St. P. & S. Ste. M. Ry.

Minneapolis, Minn., April 10, 1893.

A PORTABLE ELECTRIC HOIST.

The General Electric Company has just brought out a four-spool hoist driven by an electric motor which is designed especially for use on shipboard or on wharves or docks. It consists of a strong cast iron frame carrying a 45 HP. electric motor and two heavy shafts, each having a spool keyed on each end over a bronze bushing. This facilitates



A FOUR-SPOOL ELECTRIC HOIST.

the removal of the spool when necessary, whereas an iron to iron joint will rust fast when exposed to salt spray. Each spool is independent of the others, so that a number of loads may be raised, lowered or held, independently. Two safety pawls on each spool are held out of operation by centrifugal force when a load is being hoisted, but immediately engage with teeth on the bearing cap should the current fail, and will thus prevent the load from running down.

The motor is entirely inclosed with the exception of small openings, giving access to the brushes and armature bearings, and these are closed when the hoist is in operation. The windings of the fields and armature are covered with special waterproof composition. The apparatus for controlling the hoist is placed within the frame below the motor. The motor takes a current of either 110, 220 or 500 volts as ordered. The current consumption at 110 volts is 360 amperes.

The hoist will lift 3,000 lbs. on two spools at 250 ft. per minute. The winding spools are 12 ins. in diameter and 9½ ins. long. The hoist measures 6 ft. 10 ins. × 6 ft., and stands 4 ft. 7½ ins. high, when mounted on wheels, as shown in the illustration. Its total weight is 8,000 lbs.

The advantages of an electric hoist, which can be readily moved from place to place, over a steam or hydraulic hoist which is anchored to one spot and requires expensive pipe connections, are obvious and should lead to an extended use of the machine.

WIRE GLASS.

The breakage of glass is an item of expense which at many mills, factories, railway shops, etc., becomes rather a serious matter in the course of a year. To avoid this to some extent, thicker panes are used, and rough or ribbed glass of various styles is on the market; but when panes of this heavy glass are put at a considerable height any broken pieces have sufficient weight to form dangerous missiles, and it is considered best practice to place wire netting on the under side of the sheet to guard against this danger. In some places, however, and notably in the roofs of large train sheds, the corrosion of the wire netting is very rapid and it must be replaced at frequent intervals.

To meet the demand for an unbreakable glass for use in trainshed, mill and factory construction a process has recently been devised for imbedding wire netting in glass. The result is a sheet of glass which will stand severe pelting with hail, stones, and even with heavier missiles without material injury, as when cracks occur in the glass the wire netting holds the pane together and prevents any of the pieces from falling out.

Tests have also shown the material to have excellent powers of fire resistance. As noted in the description of the Temple Court fire in our last issue, ordinary glass cracks and falls when heated to only a moderate degree; but the wire glass although it may crack, cannot fall; and it will endure a degree of heat sufficient to melt the glass off the wire netting.

There is a great advantage, moreover, in having the wire netting imbedded in the glass compared with having it over or under it. The wire in the glass is absolutely protected from corrosion, and it offers no obstruction to cleaning the glass. With ordinary glass, cleaning must be carefully done in order not to break the panes; but wire glass can be cleaned rapidly without especial care. When cleaned by a hose a heavy pressure of water which would knock out ordinary panes can be used. Any desired thickness of glass and any gage of wire or size of netting can be furnished. The wire may be made so fine as to offer very little obstruction to light, and a much nner and cheaper pane than where plain glass is is the result. Sheets can be made of any size o 4 × 10 ft., and the glass may be either transparent, tinted, corrugated or ground. Samples of this new material and any further information may be obtained from the Manhattan Equipment Company, sales agents, 115 Broadway, New York.

SOUTH AUSTRALIAN RAILWAYS.

The report for the year ending June 30, 1892, submitted by the Railway Commissioners in November last, showed a net profit of $2,801,745, or 4.78% upon a total capital of $58,572,170, which had been expended in the construction of railways and tramways and various wharves and jetties up to June 30. Of this capital all but $2,271,255 expended out of the general revenue of the colony has been raised by loans. The working expenses for the year were 53.82% of the revenue, or 3.4% more than the previous year, the increase being due to additional train service, the partial introduction of the eight-hour system, the renewal of ballast and ties, and the lack of adequate water supply, owing to the drought. The working expenses of all the Australian colonies were as follows:

	South Aust.	Victoria.	New So. Wales.	Queensland.	New Zealand.	Tasmania.	Western Aust.
Per cent. of op. exp. to rev., 1891-92....	53.82	69.08	61.60	60.76	63.34	87.51	99.22
Per cent. of net. rev. to cap. cost on miles open	4.78	2.58	3.58	2.57	2.75	0.68	0.06

The following table gives some particulars of the traffic, financial operations and equipment of the railways.

Miles open, 3 ft. 6 ins. gage.	1,173	1,161¾
" " 5 " 3 " " .	487½	504¼
" " total.	1,660½	1,666
Capital cost, total.....	$58,572,170	$56,994,195
" " per mile.....	$35,270	$34,210
Gross earnings.....	$6,096,450	$6,119,995
Operating expenses.....	$3,264,705	$3,085,895
Net receipts.....	$2,801,745	3,034,100
Per cent. oper. exp. of gross earn.	53.82%	50.42%
Per cent. net rec. on cap. cost.	4.78	5.32%
Passengers.	5,744,487	5,295,991
Freight and stock, tons.....	1,104,122	1,174,114
Receipts per mile open.....	$3,650	$3,735
" per train-mile.....	$1.39	$1.55
Oper. exp. per mile open.....	$1,965	$1,885
" " train-mile.	75 cts.	78.6 cts.
Train-miles	4,178,286	3,769,225
Miles per passenger.....	13.52	14.04
" " ton.	101.53	87.68
Receipts per pass. per mile.....	1.66 cts.	1.74 cts
" per ton per mile.....	3.06 "	3.38 "
" per train-mile.....	138.38 "	155.88 "
Locomotives.	241	216
Cars in passenger service..	331	325
" in ft't and stock service.	5,601	5,383
Popl'n (exclus. of aborigines)..	325,000	320,000
Miles per 1,000 of popl'n.....	5.11	5.20
Population per mile of line....	196	192

With a view to effect an improvement in the car lighting, which the commissioners admit is greatly required, an agreement was entered into in 1891 with the Brush Electric Light Co. for fitting up a train with the electric light, the company to run the experimental train for six months, when it may be accepted or rejected by the commission, in accordance with the results obtained. At the time of the report the train had been running for six weeks, giving general satisfaction, and no case of the light failing had been reported. Some statistics of the South Australian railways, as compared with American railways, were given in our issue of Feb. 7, 1891, and the standard 80-lb. T-rail track was illustrated and described in our issue of Oct. 31, 1891.

FIVE-BOLT RAIL JOINTS.

The five-bolt joint with fish plates or splice bars as used with the standard 75-lb. T-rail of the Ind an State Railways was illustrated in our issue of Dec. 29, 1892, and we learn from an engineer on these railways that this form of joint is continuing to give great satisfaction wherever used. The long six-bolt joints have been found to grip the rails too tightly, causing them to buckle in the hot weather, so that orders have been issued to use only four bolts with the long splice bars.

The five-bolt joint appears to conform very closely to the hinge arrangement of the rail ends which is so desirable in securing a good and durable joint, as pointed out in our issues of Dec. 28, 1889, and Feb. 23, 1893. The center bolt, passing through notches in the webs of the rails, forms a hinge upon which the rail ends bear in deflecting, and at the same time holds the two rail ends in their relative position, so that one rail end cannot rise above the other.

WORTHINGTON HIGH-DUTY PUMPING ENGINE AT PHILADELPHIA, PA.

(With inset.)

The city of Philadelphia had in service at its various water supply pumping stations at the close of 1891, pumping engines with a total daily capacity of 184,540,000 gallons. During 1892 this was increased by a 20,000,000-gallon engine built by the Southwark Foundry and Machine Co., and contracts were let for additional engines with a total capacity of 55,000,000 gallons, which will make a total pumping capacity at the disposal of the city of 259,540,000 gallons, a greater total than that of any other city in the country, except Chicago, whose pumping engine capacity amounted to 260,000,000 gallons at the close of 1890, and has been materially increased since.

All the new pumping engines purchased by Philadelphia are of large capacity, the economy of such engines in high duty and small cost of attendance and repairs being clearly recognized. The largest of the new engines is a compound duplex direct-acting pump of 20,000,000 gallons daily capacity, the contract for which was awarded to Henry R. Worthington. The engine has horizontal cylinders and the Worthington high-duty attachment, which enables the steam to be cut off early in the stroke so that a high ratio of expansion and economy of fuel may be secured.

Our inset sheet shows a side elevation and plan of the engine, and makes evident the exceeding compactness of the machine. Its measurements over all are: Length, 38 ft.; width, 17 ft. 8 ins; height, 12 ft. 5 ins.; height from bottom of air pump well, 17 ft. 9 ins.

The contrast is enormous between this engine and the old-fashioned walking beam type of pumping engine, which is still popular abroad though almost obsolete in this country. As an illustration of this we select at random from D. K. Clark's work on the steam engine, the beam compound pumping engines at the Lambeth (London) water-works, built in 1875 by Easton & Anderson. This pair of engines has a daily capacity of 5,000,000 gallons, or one-fourth as much as the capacity of the Philadelphia engine, occupies a floor space 26 ft. 4 ins. × 18 ft., and stands 28 ft. high. The head against which it works is 230 ft., slightly higher than that of the Philadelphia engine, but not enough to materially offset its size.

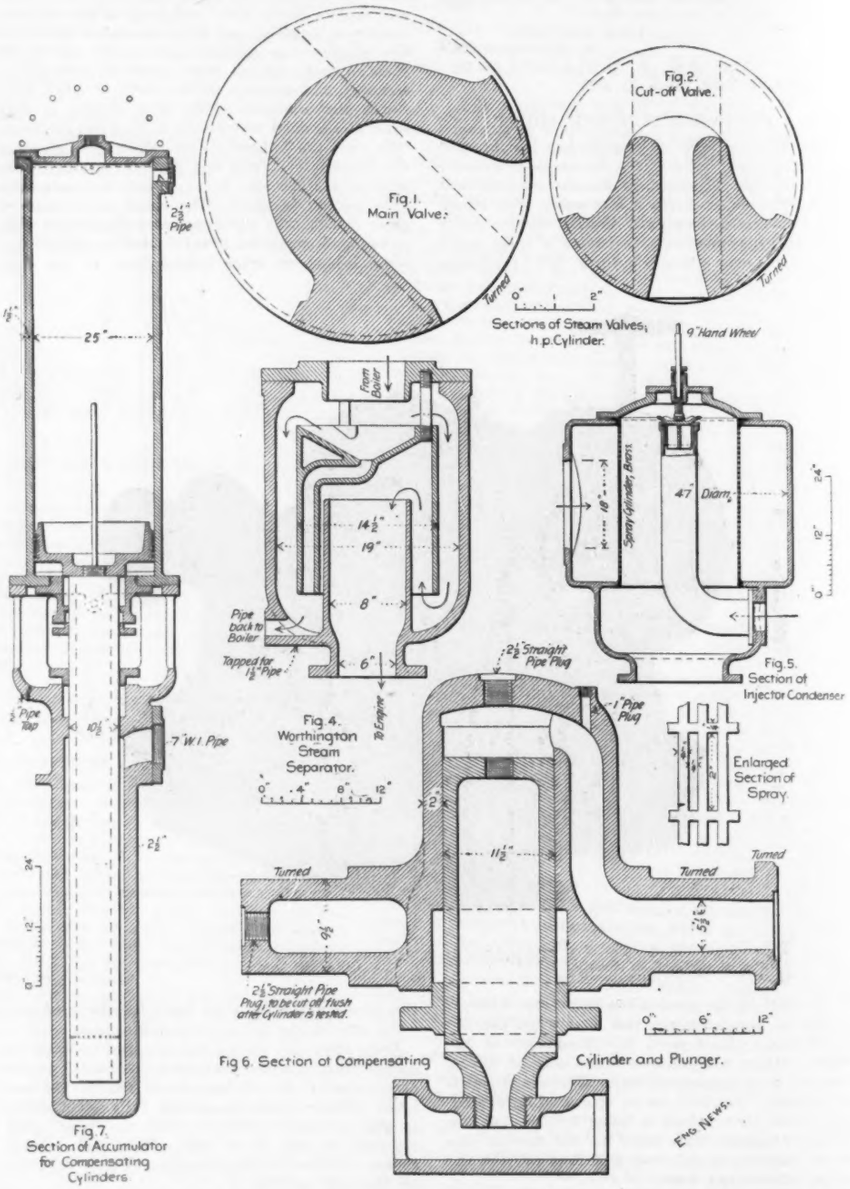
Of course the small size of the horizontal direct-acting engine means a considerable saving in the cost of the engine house, and in many places a more important saving in the ground area required therefor. Another important item of saving is in the cost of foundations. The old-fashioned engines required massive foundations, which had to sustain heavy strains from water and steam pressure. The Worthington engine is self-contained, and the foundations do little more than carry the weight of the machine. As an illustration of the expense of foundations and housing for the old type of engine, the Lambeth engine above referred to cost, with its boilers, $106,395, and the engine house and boiler house, with foundations and flues, cost about $29,000. Thus, notwithstanding the excessive cost of the engines (a sum sufficient to purchase a plant of five times the capacity in this country), the buildings to cover it and the foundations to carry it cost between one-third and one-fourth as much as the power plant itself.

Turning now to the details of the Philadelphia engine, it may be said at the outset that it embodies the principal features which are at the present day accounted good practice in pumping engine construction, including drying of the steam in a separator before its use in the h. p. cylinder, reheating the steam in an intermediate receiver before its passage to the l. p. cylinder, and steam jacketing on the heads and barrels of both cylinders. The principal dimensions of the engine are as follows:

Cylinder diameters:

	H. p., 41 ins.; l. p., 82 ins.; water,	36½ ins.
Stroke		48 ins.
Steam pressure		100 lbs.
Water "		110 "
Compensating plungers,	diam.	11½ ins.
" "	stroke	13⅜ "
" "	pressure per sq. in.	625 lbs.
Total weight of engine		600,000 "

The pump end of the engine is securely bolted to the foundations. At the steam end the low-pressure cylinder rests upon expansion plates secured to the foundations in such a manner as to prevent strains in the cylinders or frame due to expansion and contraction. The high-pressure cylinders rest upon heavy iron columns extending down to the lower part of the foundations. The valve gear is supported almost entirely by the steam cylinders. The steam valves take their motion directly from the main cross-heads; and the driving mechanism is so arranged as to transmit the strain through the connections themselves, each valve stem and arm being relieved, so far as possible, from all work other than that involved in moving its own valve.



FIGS. 1, 2, 4, 5, 6, 7. WORTHINGTON PUMPING ENGINE OF 20,000,000 GALLONS CAPACITY; PHILADELPHIA, PA.

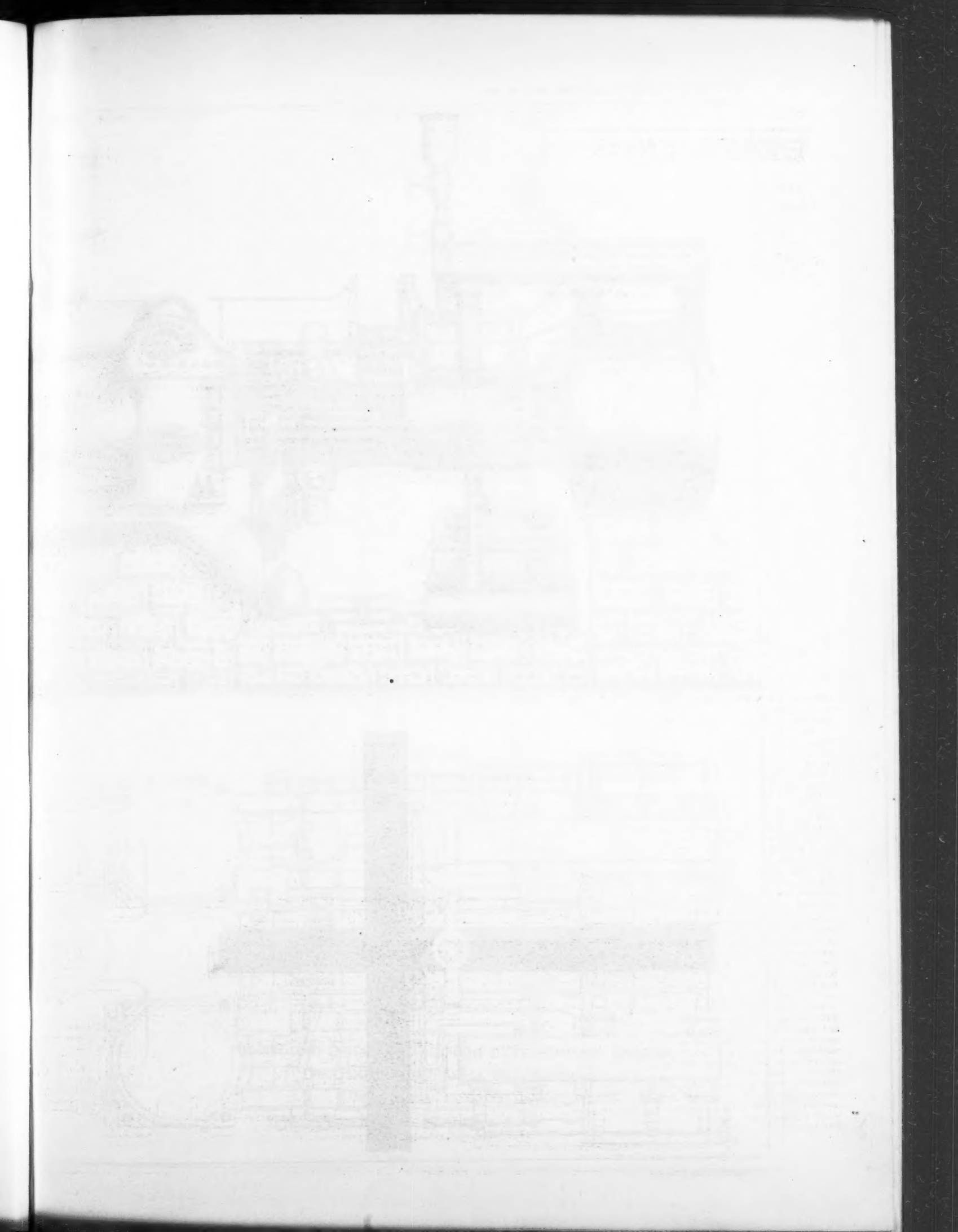
As in the regular duplex engine, the main valves of each engine are driven by the cross-head of the engine on the opposite side; but each engine moves its own cut-off valve, and the steam is therefore cut off at a given point of the stroke, no matter what the movement of the opposite side may be.

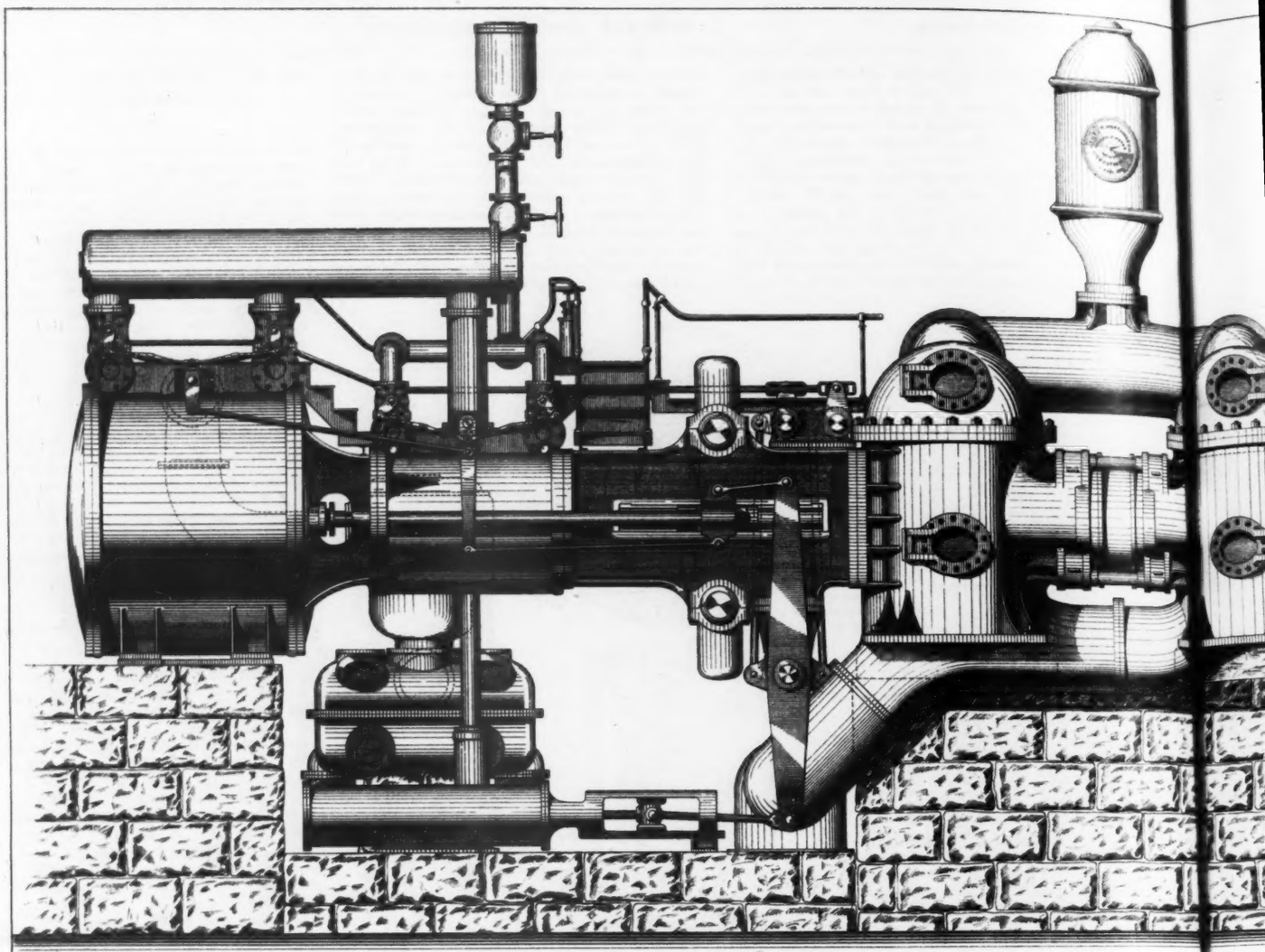
The main valves are of the semi-rotative circular type, and govern both the admission and exhaust. A section of a main valve on the h. p. cylinders is shown in Fig. 1. The cut-off valves are similar in shape and movement, but are double-ported, as shown in Fig. 2, thus giving double the length to cut-off edge, and minimizing the throttling effect as the valve closes. The arrangement of valves and ports is such as to reduce the clearance volume of the ports to a minimum. The percentage of clearance averages 2. in all the cylinders.

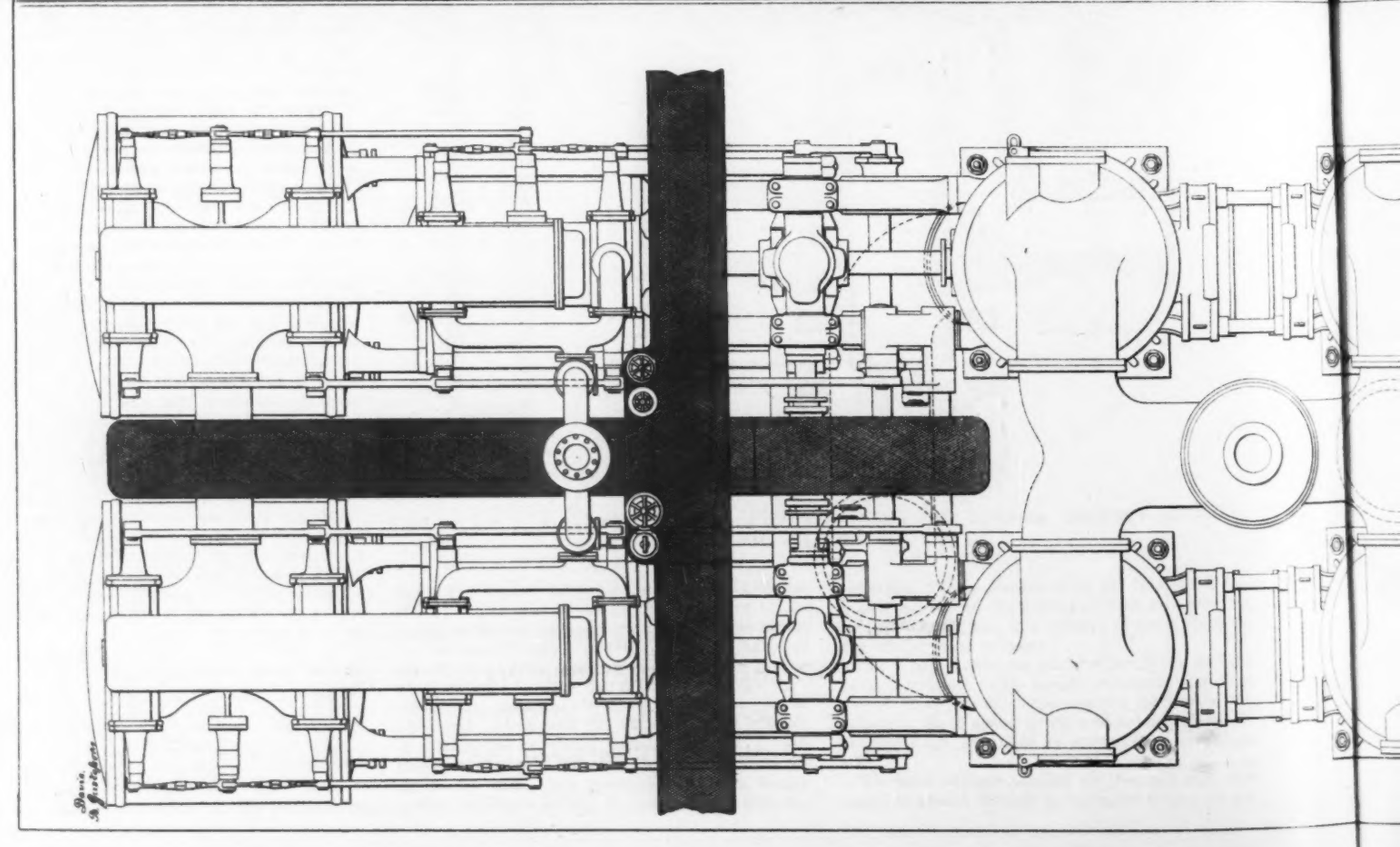
The low-pressure piston has two rods, which are set far enough apart to clear the high-pressure cylinder. These rods, with the rod from the h. p. piston, are keyed to the main cross-head, and the rod from the pump plunger is also keyed to it in line with the h. p. piston rod. This arrangement of cylinders facilitates the removal of the back heads of both cylinders for examination of the pistons or of the interior of the cylinders. Where the pistons of both cylinders are mounted on one rod, it is difficult to reach the interior of the front cylinder.

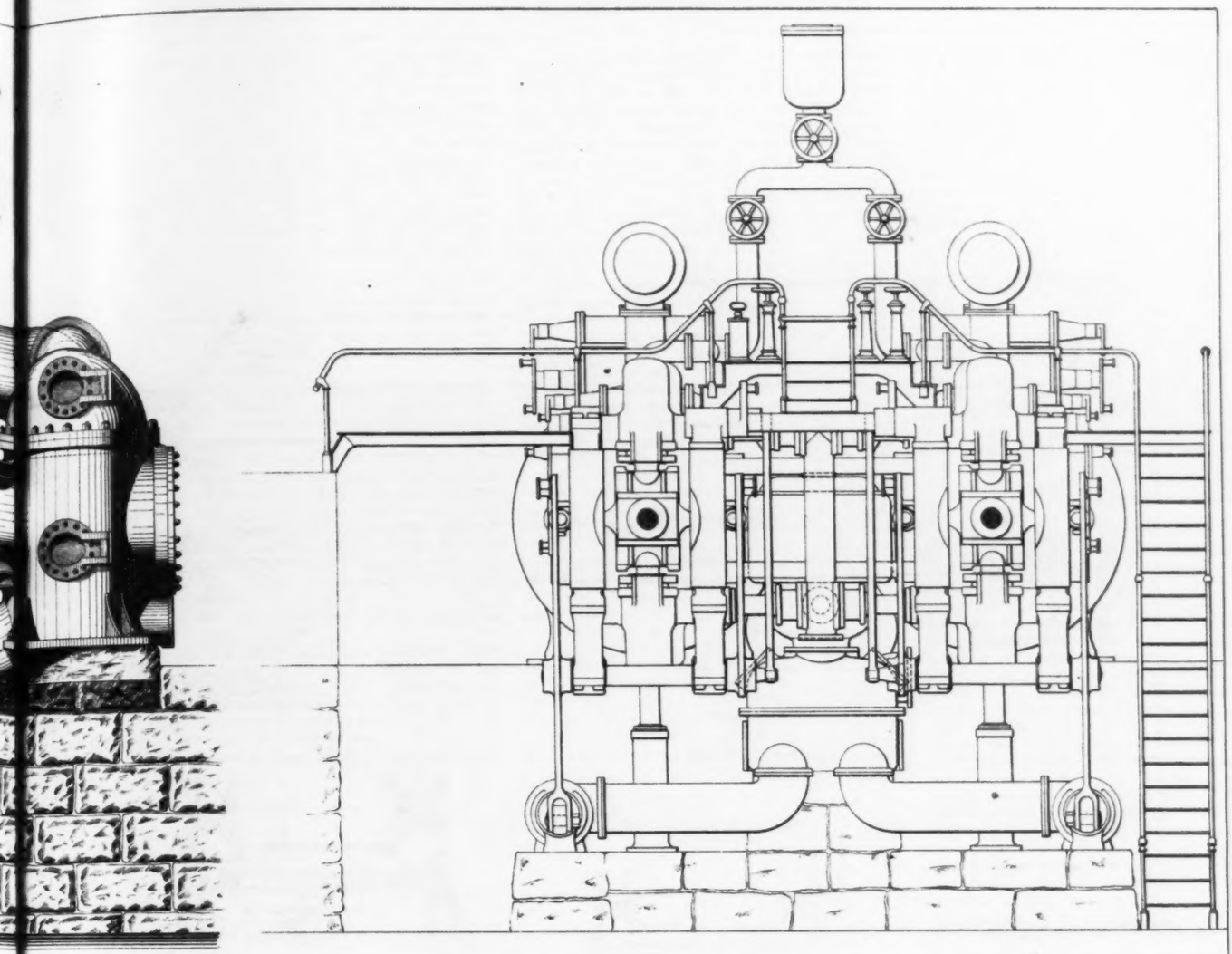
The steam pistons are made of box form, as light as is consistent with proper strength, and long enough to secure an ample wearing surface on the cylinder. Each piston is fitted with two adjustable packing rings, expanded by springs and scraped to a fit.

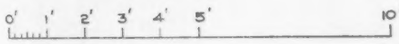
We have already alluded to the fact that the steam is passed through a separator before its en-

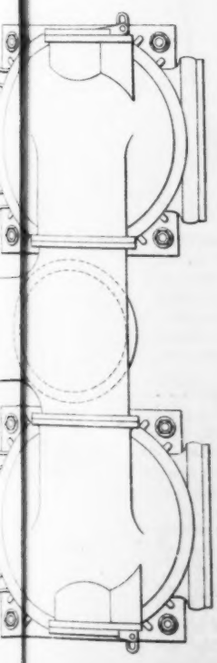


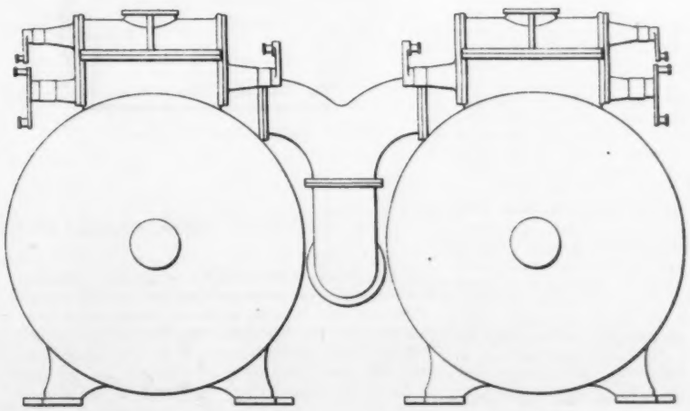












COMPOUND DIRECT ACTING HIGH DUTY PUMPING ENGINE
FOR THE PHILADELPHIA WATER-WORKS.

Daily Capacity 20,000,000 Gallons.

Henry R. Worthington, Builder.

CHAS. HART & SONS, LITH, 99 VESEY ST., N. Y.

try to the engine, which relieves it of any entrained water, and insures a dry steam supply as well as safety to the cylinders. The separator used is shown in Fig. 4, and consists of a cylindrical vessel about twice the diameter of the main steam pipe, with a height of 1½ times its diameter. The steam entering at the top deposits most of its entrained moisture on the basin just below the opening, and is further dried in its passage down the sides of the separator and up the annular space to the mouth of the exit tube; the drain pipe from the bottom of the separator conducts the condensed water back to the boiler.

It is strange that a device at once so simple and so advantageous as the steam separator should have been so long neglected; but at the present time its merits have been fully proved, and its absence in the design of a steam plant of any size is cause for criticism.

The reheater between the high and low pressure cylinders is so designed as to be free from the strains due to unequal expansion and contraction and the resulting leakages. The boiler steam passes through the tubes of the reheater, while the working steam surrounds them. The tubes are fastened at one end only to a tube plate and are closed at the other, the construction in fact being similar to a steam radiator. The strains produced where the tubes are fastened into a tube plate at each end, as in the ordinary reheater, are thus obviated. The reheater is about the size of the h. p. cylinder. Its heating surface (measuring outside diameter of the tubes) amounts to about 0.6 sq. ft. per HP.

The injector condenser, which takes the steam from both l. p. cylinders, is shown in section in Fig. 5. The cone which sprays the condensing water is adjustable by a hand wheel to regulate the amount, and the orifice cleans itself when the cone is slightly raised. The surface against which the spray strikes is perforated with

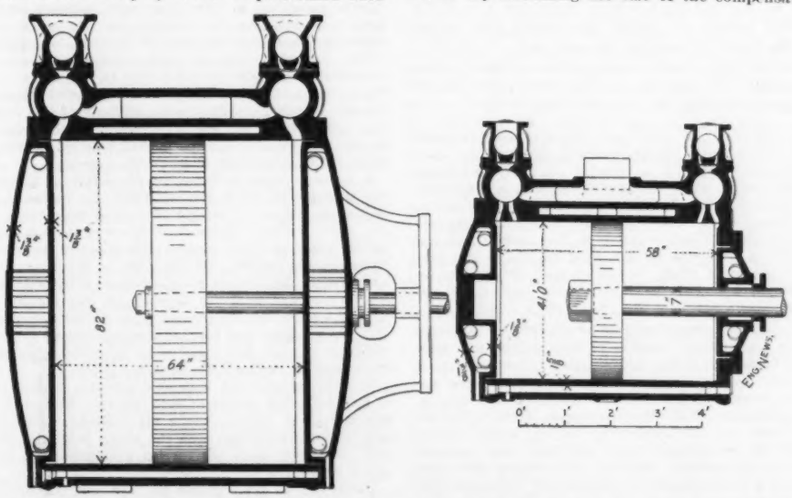


FIG. 3. VERTICAL LONGITUDINAL SECTION THROUGH STEAM CYLINDERS.

horizontal openings 2 ins. long and ¼ in. high, with bridges ¼ in. wide between them. This gives a considerable surface of chilled cold metal against which the entering steam can condense.

The air pumps are horizontal, double-acting flooded pumps, one on each side, and are driven by link connections from the main crosshead, the levers which drive them being also utilized to drive the main valve gear. The valves of the air pump are at the top of the pump case, where they can easily be reached for examination and overhauling. The plunger of the pump works always in solid water, insuring smooth motion and avoiding leakage.

The condensation from the steam jackets, the reheater and the separator is returned by an independent pump to the boilers.

It now only remains to describe the compensating cylinders, which form the high-duty attachment to the engine, and which, by storing up work on the first part of the stroke and giving it up on the last part, make it possible to cut off the steam early in the stroke, secure a high ratio of expansion and economize fuel. For a full explanation of this device reference may be made to our issues of Nov. 6, 1886, or Aug. 31, 1889. The action of the compensating cylinders may easily be understood, however, by an examination of the general elevation on the inset sheet. As there seen, these cylinders oscillate on trunnions, and are suspended in large pillow blocks contained within the framing of the engine. When the engine begins its stroke the compensating plunger is at an angle of about 35° with the horizontal, and the engine must force the plunger into the cylinder as it moves. At midstroke the plunger axis is vertical, and at the end of the stroke it is inclined at an angle of 35° in the opposite direction. There are two compensating cylinders to each side of the engine, or four in all. Fig. 6 shows a section of one of them, with the plunger in place. The pressure on the plungers with 110 lbs. pressure in the force main is nearly 625 lbs. per sq. in., or nearly 125,000 lbs. When the plunger is at either end of the stroke, and nearest parallel with the line of motion of engine, the horizontal component of this pressure amounts to about 78% of the load on the pump plungers. Of course it rapidly falls off as the plunger moves toward its vertical position, and when this is reached at midstroke the plunger pressure is reversed and pushes the engine in the opposite direction.

It remains to be explained how the pressure on the back of the plunger is kept up. Fig. 7 shows a differential accumulator set in any convenient place and connected by pipes to the main air chamber of the pump and to the trunnions of the compensating cylinder. Thus the pressure in the force main is multiplied in the ratio which the areas of the pistons of the differential accumulator bear to each other.

It will be understood that the accumulator is not an essential feature of the high-duty attachment. By increasing the size of the compensating cylinders the force main pressure might be admitted directly to the trunnions, and this is done with some pumps working against high pressure. The advantage of the accumulator is that it decreases the size of the compensating cylinders and also the loss by friction in moving them, the friction of the accumulator itself being very small.

The accumulator in this engine has a total vertical movement of 72 ins., but the ordinary travel is very slight, for as one pair of plungers moves inward the pair on the opposite side moves outward. The main object of giving the accumulator considerable travel is to permit variations in the volume of air in the air chamber. To prevent breakage in case the ram should reach the end of its stroke in either direction, relief openings are provided on the ram and a cushion at the lower end of the large cylinder.

Turning now to the pump end of the machine, each engine works a double-acting, outside-packed plunger pump. The valve chambers are cylindrical and vertical, and are connected together in the line of motion by the plunger barrels, stuffing boxes and heavy tie rods, the latter being so arranged as to completely relieve the joints from strains due to the engine's working. The valve chambers are connected at their upper ends by cross-delivery pipes, terminating in a single outlet for the force main and surmounted by a large air chamber. The main suction pipe, commencing in one large inlet, branches at the top of the well to either side of the engine, and extends beneath the valve chambers, delivering the water immediately beneath the suction valves. These are seated upon a diaphragm near the lower ends of the valve chambers; and the delivery pipes are similarly situated at the upper ends. The pump valves consist of rubber disks 4⅝ in. in diameter, working upon brass stems screwed into brass seats, and controlled by composition springs. The valve seats are screwed into the diaphragms formed in the pump chamber castings, and the aggregate area of the openings in the seats is large enough to permit the flow of water through them at not over 5 ft. per second, when the pump is running at its maximum speed.

The peculiar arrangement of the main suction pipe, leading to the inner end of the pump instead of the outer end, is due to the fact that the engine replaces a much smaller one, and the location of the well could not be changed except at considerable expense.

The engine is not fitted with a governor, the load on a pumping engine delivering water into a reservoir being so uniform that a cut-off adjustable by hand, meets sufficiently well the demands of economy. The chief office of a governor on a pumping engine working under a constant load is to protect the engine from injury in case the water pressure falls from the bursting of a main. This the high-duty attachment of the Worthington engine effects with great simplicity. The pressure on the plungers of the compensating cylinders depends entirely on the pressure in the mains. If this falls to zero the compensating plungers become mere inert masses of iron. The piston starts quickly at the beginning of its stroke, but the steam is soon cut off, and before it reaches the end it has expanded to so low a pressure that the engine will come to a stop, the aid of the accumulator being lacking. It is stated that this has been demonstrated several times in actual practice during the past three or four years. The most notable case, probably, was that of a Worthington high-duty engine working on an oil pipe line at 1,000 lbs. per sq. in. pressure. The force main burst outside the engine house, and the first intimation those in charge had of the occurrence was the quiet stopping of the engine.

The timbered lands of the state of Texas aggregate 25,000,000 acres, says the Dallas "Morning News." Of the 245 counties in the state only 40 are classed as timber counties, with 10 growing the long-leaf pine and the remainder producing the short-leaved variety. The price of these lands ranges from $2 to $12 per acre, according to accessibility, quality and estimated stumpage. The state still owns about 90% of these lands. The lumber product of the state for 1891 shipped on the railways amounted to 2,221,796 tons of lumber, or about 75,000 carloads, equal to one-fifth of all the state railway tonnage for the year.

The use of electric street cars for local mail service is to be used at Cleveland, O., and preparations are being made to introduce mail cars on the street railways in order that the mail matter to and from the outlying sections of the city may be more expeditiously delivered and collected. The idea is to carry mail clerks on each car who will sort the mail on the car, instead of at the office. St. Louis has tried the experiment and found it very convenient.

The Minnesota Canal Co. has been incorporated, in St. Paul, Minn., with a capital of $20,000,000. The alleged purpose of the company is to build a canal between the Mississippi River and Duluth, deep enough to permit light-draft boats loading at Buffalo, N. Y., to unload at St. Paul. They say the present cost of transporting a ton of anthracite coal from Buffalo is $1.80, and they think they can reduce this to 80 cts. The scheme, however, is very much in the air, as yet.

The U. S. cruiser "Detroit," in her trial trip in 11 to 27 fathoms of water in Long Island Sound, developed a speed of 20 knots per hour, in her 4-hour trial. The average speed was estimated at 18½ knots. The engines made 170 to 176 revolutions per minute under 163 lbs. steam pressure. This record is said to make the "Detroit" the fastest cruiser of her displacement in the world. She exceeded her contract speed by 3 knots per hour.

A YEAR'S RECORD OF AN ELECTRIC STREET CAR LINE.

We reprint from our contemporary, the "Street Railway Review," the accompanying record of earnings, operating expenses and coal consumption by months on an electric street railway of moderate size. The name and location of the road are not given; but it is stated that the character of the service rendered is rather better than the size of the town warrants.

Coal Consumption on an Electric Railway, by Months.

1892.	No. Cars Operated per Day.	Coal used per month, tons. Soft coal at $2.25 to $2.35.	Coal used per month, tons. Hard coal dust at 25c. to 65c.	Coal used per month, tons. Total.	Coal used per day. Lbs.	Lbs. per car.	Coal used per car mile lbs.	Total value of coal used per month.	Cost of coal per car mile, cts.
Jan.....	22	355 0	.....	355.0	22,903	1,041.04	9.35	$800.49	1.654
Feb.....	22	353.5	.....	353 5	24.379	1,108 13	8 99	779.19	0.991
Mar.....	23	336.2	.....	336.2	21,690	943.04	8.39	735.67	0.919
Apr	24	358.7	.....	358.7	23,916	996.50	8.20	809.38	0.925
May.....	24	292.9	89 5	342.4	22,093	920.54	7.54	622.49	0.685
June	24	179 7	116.1	295.9	19,726	821.70	6.70	455.59	0.527
July.....	24	243.4	56.9	300.4	19,380	807.50	6.41	591.00	0.650
Aug. ...	24	312.4	65.1	377.5	24,353	1,014.91	7.36	724.10	0.706
Sept	24	256.6	90.9	347 5	23,170	965.41	6.56	596.30	0.588
Oct.	29	361.9	111.3	473.2	30,533	1,052.52	7.89	910.07	0 769
Nov	31	392.5	65.0	447.5	29,833	962.41	7.57	971.46	0 822
Dec	31	380.7	148.0	528.8	34,116	1,100.51	8.37	1.011.80	0.801
Average per mo...	25	.....	.....	376.4	24.082	987.28	7.76	754.79	0,779

Earnings and Operating Expenses of an Electric Railway, by Months, in 1892.

	Mileage.	Passengers.	Gross earnings. Amt.	Gross earnings. Aver. per car-mile.	Operating Expenses. Office and superintendence. Amt.	Office and superintendence. Aver. per car-mile.	Motive power. Amt.	Motive power. Aver. per car-mile.	Transportation. Amt.	Transportation. Aver. per car-mile.	Maintenance of cars and motors. Amt.	Maintenance of cars and motors. Aver. per car-mile.	Maintenance of way. Amt.	Maintenance of way. Aver. per car-mile.	Total operating expenses. Amt.	Total operating expenses. Aver. per car-mile.	Net earnings. Amt.	Net earnings. Aver. per car-mile.	Op. exp. per pass.	P. c. op. exp. to gross earnings.	Cars run per day., No.	Av. earnings per car.
Jan..	75,923	223,141	$11,137	$.14085	$415	$.00516	$2,216	$.02918	$1,202	$.03534	$1,866	$.02488	$792	$.01042	$6.491	$.12500	$1,606	$.02193	$.04253	85.06	22	$19.35
Feb..	78,588	221,227	11,061	.14074	417	.00530	1,939	.02505	4,386	.05581	1,957	.02528	942	.01198	9,702	.12344	1,360	.01730	.04385	87.70	22	17.33
Mar..	80,045	242,157	12,108	.15125	422	.00523	1,584	.01979	4,572	.05711	2,091	.02611	1,802	.02251	10 471	.13081	1,636	.02044	.04324	86.48	23	16.38
Apr..	87,413	285,389	14,269	.16324	406	.00464	1,666	.01905	4,632	.05298	1,437	.01644	693	.0 690	8.744	.10003	5,525	.06320	.03064	61.28	24	19.81
May..	90,811	314,751	15,738	.17330	264	.00291	1,508	.01660	4,850	.05340	1.2 3	.01357	409	.00450	8,264	.09100	7.473	.08229	.02625	52.51	24	21.15
June.	88,306	312.778	17,119	.19380	270	.00305	1,396	.01580	4,811	.05448	1,414	.01601	285	.00322	8,175	.09257	8.939	.10122	.02388	47.77	24	23.76
July.	93,687	336,097	19,305	.20695	215	.00229	1,533	.01636	4,912	.05243	1.337	.01427	496	.00528	8,493	.09065	10,812	.11540	.02199	43.99	24	25.94
Aug..	102,526	385,603	19,330	.18853	319	.00310	1,497	.01460	5,352	.05220	1,141	.01112	200	.00194	9.509	.08290	10,821	.10554	.02200	44.01	24	25.58
Sept.	101,285	372,053	18,603	.18366	309	.00305	1,508	.01489	5,539	.05468	1,251	.01234	259	.00255	8,866	.08754	9,736	.09612	.02383	47.66	24	25.83
Oct...	119,854	450,620	22,531	.18798	315	.00262	1,966	.01640	6,671	.05565	1,494	.01246	377	.00314	10,822	.09029	11,709	.09769	.02401	48.03	29	25.06
Nov..	118,136	412,773	20,639	.17471	331	.00280	2,039	.01726	6,532	.05529	2,774	.01925	1,401	.01188	12,580	.10649	8,059	.06821	.03047	60.95	31	22.19
Dec..	106,314	368,434	18,422	.17327	420	.00395	1,657	.01558	6,447	.06063	2,007	.01887	1,043	.00981	11,574	.10886	6,847	.06440	.03111	62.83	29	20.38
	1,142,885	4,005,523	$200,276	$.17523	$4.103	$.00359	$20.540	$ 01797	$62.906	$.05504	$19.532	$01709	$8.611	$.00753	$115,693	$.10122	$84.583	$.0740	$.02889	57.76	25	$21.88

The car shed, to which are attached a repair shop and the company's offices, contains four parallel lines of rails provided with a cleaning pit each, and intercommunicating by a transfer table, and a turntable, there being no outside space for sidings. Three tracks are loading lines, two being used during the day exclusively for the cars running in for loading and out for service, while the third is used for one or two cars standing always ready loaded in case of accident or special service, and the fourth track serves for the empty reserve cars and those undergoing repair.

The charging plant is placed at the end of the three loading tracks, and consists of four superposed horizontal pipes of 1.2 ins. inside diameter running along the wall, and of the gage, regulator, and valve apparatus surmounting them, and fitted in the center. The uppermost of the pipes connects direct with the main from the air-compressing station, which passes through the accumulator room, and there also connects with the accumulator battery. The second pipe connects with the accumulators, but is also connected with the compressed air main; the third is the steam pipe, and the fourth the water pipe, both connecting with the boilers in the accumulator room. The discharge from these pipes, on the loading of the cars, takes place through upright connecting pipes and two valves governed by two corresponding sets of regulators marked "Water" and "Air" respectively, the pressure in the compressed air, accumulator, and steam pipes being registered by three corresponding pressure gages fitted above the valves and regulators. There being only one valve regulator and gage apparatus for the three lines of rails, one car only, stationed on one or other line, can be loaded at one time, the connections of the other two lines being cut off in the meantime. This is a disadvantage, especially when an increased ordinary or an extraordinary traffic on special occasions requires the dispatching of several loaded cars in quick succession; and to meet this contingency each line of rails should be provided with its own regulator, valve, and gage apparatus, so as to enable two or three cars to be loaded simultaneously.

Each car, with front and back platforms, rests on two iron frames. The lower edge of the outside frame, composed of plates and angle irons, with diagonal bracing, is 5.9 ins. above the head of the rails, so that the compressed air cylinders, as well as the motors, are effectually concealed and protected. The smaller inside center frame serves for the axle bearings, the motor cylinders being placed between the two frames.

The engine is constructed like an ordinary steam tramway locomotive, and drives two coupled axles, the wheel base being 5.2 ft. It has a pair of outside horizontal cylinders, 5.1 × 8.6 ins.; four coupled wheels, 27.5 ins. diameter, and the total weight of the car when full is about 9.5 tons. The authorized speed is about 7 miles per hour. Taking the resistance due to the grooved rails and to curves under unfavorable conditions at 30 lbs. per ton of car weight the engine has to overcome on the steepest grade, 5%, a total resistance of about 0.63 ton, and has to develop 25 HP. At the maximum authorized working pressure in cylinders of 176 lbs. per sq. in. the motors can develop a tractive force of 0.64 ton. This maximum is, therefore, just sufficient to take the car up the 5.2% grade, while on the flatter sections of the line the working pressure does not exceed 73 to 147 lbs. per sq. in. Sand has to be frequently used to increase the adhesion on the 2% to 5% grades.

Between the two car frames are suspended ten horizontal compressed air storage cylinders, varying in length according to the available space, but of uniform inside diameter of 17.7 ins., composed of riveted 0.27-in. sheet iron, and tested up to 588 lbs. per sq. in. These cylinders have a collective capacity of 64.25 cu. ft., which, according to Mr. Mekarski's estimate, should have been sufficient for a double trip, 3¾ miles. The trial trips, however, showed this estimate to be inadequate, and two further small storage cylinders had therefore to be added of 5.3 cu. ft. capacity each. These had to be placed lengthways under the seats of the car, bringing the total cubic contents of the 12 storage cylinders per car up to 75 cu. ft., divided into two groups, the working and the reserve battery, the former of 49 cu. ft., the latter of 26 cu. ft. capacity.

A pressure gage indicates to the driver at all times the pressure to which the air inside the valve-box has expanded, while by means of a three-way valve the air, under reduced pressure, is allowed to pass either to the cylinders of the motors or to those of the brakes, or is entirely cut off. On the right of the driver there are fixed to the heating chamber three other valves, of which two are used for loading air and steam, and a third admits the air coming from the loading station into the working and reserve storage cylinders or batteries of the car, the pressure in these batteries being registered by two separate pressure gages.

Each car is provided with an air brake, consisting of a pair of small cylinders into which compressed air is admitted by the three-way valve already mentioned, and whose pistons act upon the brake blocks. Besides this air brake each car carries a single-acting hand-screw brake.

There are 16 seats inside the car and 12 standing places on the back platform, making 28 passengers, or, together with the driver on the front platform and the conductor, at 165 lbs. each, a load of 2.25 tons. The weight of the car, including compressed air, is 7.25 tons, the total weight therefore 9.5 tons, while the width is 6.56 ft., and the total length 23 ft., with a wheel base of only 5.25 ft. The overhang of the back platform, 8.65 ft., is excessive, the more so as the load of 12 passengers and the guard which it has to support equals nearly 1 ton, or 45% of the entire passenger load, and is insufficiently balanced by the heating chamber and passenger load in the front part of the car. On the other hand, the closed part of the car, with only 16 seats, is too small, and the car as a whole can certainly not be said to be well proportioned. The noiseless motion of the car renders a loud and effective caution signal necessary, and this, instead of the usual bell or whistle, consists of a horn, the car showing, moreover, at night, large red and green lights on the right and left, and two large white lights with reflectors on the front or driver's platform, on which is also placed a small coke stove which supplies hot water for heating the car during the winter season. The cars are fitted with two buffers in front, and a coupling bar at the tail for attaching a trailing car, which, however, is never done on the Berne line.

With an experienced staff, the operation of completely refilling and loading an empty car in the morning and getting it ready for service takes about 30 minutes;

THE MEKARSKI COMPRESSED AIR TRAMWAY AT BERNE, SWITZERLAND.

The application of compressed air for the propulsion of street cars has been a fruitful source for the design of various inventions and devices, only a few of which have proved practically successful. Among the successful systems is the well known Mekarski system, described and illustrated in our issues of May 24 and 31, 1890. For suburban lines and lines with light traffic the advantages of independent motors are very considerable. The Mekarski system is in regular operation at Nantes and Paris, France, on lines which are practically level, but it has also been introduced in Berne, Switzerland, on a line about two miles long, with grades of 0.25% to 3.7% and 5.2%, and has been in regular operation for over twelve months.

In the Mekarski system the air is compressed by a stationary plant and forced into storage cylinders carried under the car, the air passing to a pair of driving cylinders, and operating the engine by expansion in the cylinders, in the same way that steam is used in a steam engine. A special feature of the Mekarski system is the heating of the air, to maintain it at a constant temperature, by passing it through superheated water at 330° F. The air thus becomes saturated with steam, which subsequently partly condenses, its latent heat being absorbed by the expanding air. Without this, the temperature of the air would fall so rapidly that it would be practically useless for motive power.

In the compressor station are four compressors, driven by gearing from a shaft driven by belts from the turbines at the city's power station. The compressors are horizontal, of 35 HP. each, and three of them are in regular operation, with the fourth for reserve. The turbines and main shaft make 130 and 207 revolutions per minute, respectively, and the compressors make 80 strokes per minute. Each compressor has two cylinders, the larger one compressing the air to 73 lbs. per sq. in. and the smaller one to the maximum of 469 lbs. per sq. in. The pressure in the car reservoirs is

back of the car shed, where there are also three vertical boilers to supply the steam and water for the heating chamber on each car.

The following is an abstract of an article in "Engineering," of London, by Mr. C. S. Du Riche Preller, describing the line at Berne:

that of reloading and turning a car during the day occupies about 15 minutes, the work of reloading, properly speaking, being performed in about eight minutes. Each car in its turn remains at the station one day out of seven for the cleaning of the machinery and the regulating of the brakes.

The main line traverses the town from east to west, and measures two miles, within which, being a single line, it has about eight passing places about 66 yds. in length. The curves have a minimum radius of 164 ft. on the main line, and 98 ft. in passing places and terminal sidings represent 27% of the whole length, while the steepest grade is 5.2%. The track consists of grooved "Demerbe" rails and automatic turnouts, without cross-ties or longitudinals under them. The rails rest on a gravel foundation, or on concrete where the soil is loose, and are kept to gage by flat iron tie bars 6.56 ft. apart. It is surprising that this type of tramway rail should have been adopted, seeing that it is everywhere being replaced by the Phoenix girder rail, or the Haarmann or the Marsillon system (double flange rails). The inherent defects of weakness and of insufficient depth of groove of the Demerbe rail go a long way to account for the considerable extra resistance which the cars at Berne have to overcome, more especially on curves where the grooved rail, moreover, precludes the gage being widened. As the line is being laid in the center of the paved roadway, the outer rail is not raised, except in a few places where the superelevation is 1 in. The width of excavation for laying the permanent way is 6.56 ft. to a depth of 10 ins. The weight of the rails and track, including fastenings, is 66 lbs. and 142 lbs. per yd., respectively. The extensions will be laid on one side of the road with heavy and deep-grooved Phoenix girder rails, although on suburban roads single flange rails, with guard rails on sharp curves and at cross roads, would be at once more efficient for adhesion, and more economical, seeing that the present cost of Phoenix track is, including laying, $4.75 per yd.; as against only $3.75 per yd. of line laid with 40-lb. to 44-lb. flange rails. Pending the erection of the requisite new compressed-air plant, the suburban extensions are to be worked with 17-ton steam locomotives.

The total cost of the main line, including turbine transmission, compressing, accumulator, and loading stations, carshed, repair shop, offices, passenger huts at stopping places, and 10 motor cars ($3,000 each, complete), was $92,000, equal to $48,960 per mile.

The works of the line were carried out under contract by Mr. Anselmier, of Berne; while the compressed-air plant and motor cars were supplied by the Berne Maschinen Fabrik, from the designs of Mr. Mekarski, of Paris. The inadequacy of the calculations and estimates in some important particulars, in relation more especially to the supply of compressed-air and to the tractive force of the motor cars, entailed during the execution of the works a good many modifications and consequent delays.

The number of single journeys made per day of 14 working hours is 160, equal to about 300 car-miles, the mean number of passengers in the year 1891 being 3,140 per day, or about 20 per car journey. The carrying capacity of 28 passengers per car was therefore utilized at the mean rate of about 60%. The population of the city of Berne being 50,000, the traffic on the line was equal to 23 passengers per head of population, which is a fair criterion for the first working year on similar tramways. The authorized fares are at the rate of 2 cts. per mile; the gross earnings in 1891, which were greatly in excess of the original estimate, amounting to 40,634 fr. per kilometer, or $13,000 per mile, equal to $250 per mile per week. During the whole year the service was carried on with the greatest regularity, except during the severe frosts in the winter of 1890-91, when it was occasionally interrupted, owing to the supply of compressed air failing, consequent upon ice forming in the old main pipe. This ice had to be dissolved by the pipe being embedded in hot sand. The removal of snow from the line after an exceptional fall was speedily effected by a salt trolley provided for the purpose. The working expenditure works out as follows:

	Per mile, $.	Per car-mile, cts.	Per cent.
Administration	865	1.48	8.3
Maintenance of line	385	0.66	3.7
Traffic	1,770	3.00	16.7
Motive power	6,945	11.74	66.0
Sundries	565	0.96	5.3
Total	10,530	17.84	100.0

Motive Power.

	Per car-mile, cts.
Wages, $20	5.86
Turbine power, per HP., oil, fuel	3.72
Maintenance and renewal of plant and motors	1.86
Sundries	0.30
Total	11.74

As the gross receipts were 21.4 cts. per car-mile, the working expenses are equal to 83% of the former, and the net earnings of $2,153 per mile represent already in the first working a return of 4.4% on the capital cost of the undertaking.

From the results of six official trips, of which the details were published at the time by Mr. A. Bertschinger, C. E., of the Federal Railway Department, the writer has worked out the varying pressure and the mean consumption of air during a double journey per motor car, as follows:

Storage cylinders.	Working. lbs. per sq. in.	Reserve. lbs. per sq. in.
Pressure of air on starting	440	440
Pressure of air at end of up journey	176	260
Pressure of air at end of down journey	103	176
	Lbs.	
Consumption of air at end of up journey	92	
Consumption of air during down journey	31	
Consumption or air during both journeys	123	

This has been fully confirmed by the working experience of 1891, when the consumption of air per motor car and double journey was as follows:

Minimum, 103 lbs	28 lbs. per car-mile.
Maximum, 154 lbs	42 " " "
Mean, 123 lbs	35 " " "

The principal advantage of the compressed-air system for urban and suburban tramway traffic as worked at Berne consists in the pleasing appearance of the motor cars, if properly proportioned; in the absolutely smooth and noiseless motion; in the total absence of smoke, steam, or heat, of overhead or underground conductors, of the more or less grinding motion of most electric cars, and of the jerkey motion to which underground cable traction is subject. On all these grounds the system has fully vindicated its claims as being preferable to any other so far known system of mechanical traction for street tramways. Its disadvantages, on the other hand, consist in the extremely delicate adjustment of the different parts of the system, in the comparatively small supply of air carried by one motor car, which necessitates the car returning to the depot for refilling after a run of only four miles or 40 minutes, although on the Nogent and Paris lines the cars, which are, moreover, larger, and carry the outside passengers on the top, run seven miles, and the loading pressure is 547 lbs. per sq. in. as against only 440 lbs. at Berne. Longer distances in the same direction would involve either more powerful motors, a larger number of storage cylinders, and consequently heavier cars, or loading stations every four or seven miles; and in this respect the system is manifestly inferior to electric traction, which easily admits of a line of 10 to 15 miles in length being continuously fed from one central station without the loss of time and expense caused by reloading. The working expenditure at Berne was, in 1891, 1.4 cts. per passenger; the gross receipts being 2 cts. per passenger, so that lower fares than those charged, viz., 2 cts. per mile, would not be remunerative. Moreover, the percentage of working expenditure can be kept within 83% only by the low cost of the primary hydraulic motive power. If, instead of by water power, the air pumps had to be driven by steam, the cost of primary motive power would be increased owing to the high cost of coal—$8 per ton in Switzerland. Nevertheless, for the extensions the company contemplates primary steam power, which is also used at Nantes and Nogent, and admits of the engines, the pumping accumulator, and loading station all being in one central station, thus admitting of a better organization, and compensating in part the extra cost by saving the expense and loss of power due to the turbine transmission and compressed-air main of the present installation. It may, however, be averred that as primary power for such compressed air installations, gas engines actuated by town or Dowson gas might be more economical than steam.

The cost of working the Berne line is compared, in the annexed table, with some other tramways worked under similar conditions by horse and mechanical traction for the year 1891. As is seen, both in the case of compressed air and of electric traction, the cost of working is considerably increased where steam at a high cost of fuel has to be used instead of hydraulic power. Given the latter, the cost of working by air is about the same as that by steam locomotives or steam cars; but over both of these last-named, compressed-air offers, at equal cost and for such short lines with constant traffic, certain advantages:

1891.	Length of line. Miles.
Geneva, city	8.68
Zurich, city	5.58
Geneva, suburban	40.30
Mulhouse, city	18.00
Montreux, suburban	6.82
Florence, suburban	4.96
Tours, suburban	6.20
Nogent (Paris), suburban	7.44
Berne, city	1.86

Motive power.	Construction and equip't, per mile, $.	Operation per car-mile, cts.
Horse	60,800	19.4
Horse	39,700	11.6
Steam locomotive	32,000	13.2
Steam locomotive	22,400	17.8
Hydro-electric	20,800	10.4
Steam-electric	32,000	20.0
Steam cars	19,200	17.2
Steam-compressed-air	46,100	25.6
Hydro-compressed-air	48,950	17.8

A concession has been granted for a railway in Mozambique, on the east coast of Africa, extending from Quilimane, on the coast, to Chamo on the Shire River, with a branch to the Zambesi. The line is to be metre gage.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

OHIO SOUTHERN.—Active progress is being made on the extensions of this railway from Springfield to Lima and to Willston, O., 70 and 15 miles, respectively and it is expected to have the Lima extension in operation by June 1. The work is generally light with the exception of the belt line in Springfield and about five miles in Sangamon county. There is a bridge over the Miami River near Quincy, O. This bridge consists of 950 ft. of steel viaduct 70 ft. high, and a 150 ft. deck span supported on steel towers. The Edge Moor Bridge Works, of Wilmington, Del., are the contractors.

ELKHART & WESTERN.—Bick & Glouse, of Toledo, O., have the contract for grading this railway from Elkhart to Mishawaka, Ind., 11 miles, and began work April 10. The line is to be completed by July 1.

ATLANTIC & NORTHWEST.—Bids will be received until April 25 for grading the Northern Ontario Extension west from Eganville, Ont. Gen. Supt., C. W. Spencer, Montreal, P. Q.

AKRON & NEW CASTLE.—The contract for constructing this railway from Akron to Mogadore, O., has been let to McCracken & Semple. Work will begin at once.

FINDLAY, FT. WAYNE & WESTERN.—At a recent meeting of the directors it was voted to extend the line from Findlay, O., east to New London, Huron Co., O., at once.

LANCASTER & HAMDEN.—It is stated that the engineers of this company are preparing to make surveys and begin the construction of its railway. E. P. Buell, Tarlton, O.

Projects and Surveys.

POUGHKEEPSIE & NEW HAMBURG.—Chartered in New York to build a steam railway from the Hudson River at New Hamburg, N. Y., northwest to Wappinger's Falls and thence southeast to the highway leading from Poughkeepsie to New Hackensack. John P. Wilson, Poughkeepsie, N. Y. This is probably a passenger railway only.

CROSS FORK.—Chartered in Pennsylvania to build a railway from Shingle Bolt Summit to Cross Fork. Capital stock, $130,000. Pres., Wm. I. Lewis, Coudersport, Pa.

BOSTON & NOVA SCOTIA COAL & R. R. CO.—The incorporators of this company are: J. W. Chandler and John C. Cobb, of Boston; David S. Baker, Jr., of Providence, R. I.; William J. Fraser, of Halifax, N. S.; A. C. Ross, of North Sydney; ex-Mayor Patrick O. Mullen, of Halifax; R. H. Fraser, of Pictou, N. S., and John McKeen, of Mabou, N. S. The mines controlled by the syndicate are known as the Board Cove and Chimney Corner groups, estimated to contain 200,000,000 tons of coal.

Southern.—Existing Roads.

NORFOLK & WESTERN.—It is stated that a branch will be built from Dulgness to Wayne, C. H., W. Va.

OWENSBORO, FALLS OF ROUGH & GREEN RIVER.—The branch from Falls of Rough to Horse Branch, Ky., has been completed and will soon be opened for traffic.

CHESAPEAKE & OHIO SOUTHWESTERN.—The stockholders will meet on June 13 for the purpose of considering and acting upon the proposed purchase of the Hodgenville & Elizabethtown Ry. and the extension of same from Hodgenville to Scottsville, Ky.

CHARLESTON, CLENDENIN & SUTTON.—The tracklaying has been completed from Charleston, W. Va., north 20 miles, and one mile more remains to be laid to complete the line to Clendenin, W. Va. The road will be extended from Clendenin to Sutton, 80 miles. Pres., F. W. Abney, Charleston, W. Va.

CHARLESTON, CINCINNATI & CHICAGO.—The Cincinnati papers state that Lawrence Hunt, Pres. of the Cincinnati, Portsmouth & Virginia R. R., heading a party of capitalists, has secured absolute control of the Charleston, Cincinnati & Chicago R. R. The road was chartered Sept. 30, 1886, the project being the construction of a line from Charleston, S. C., to Ashland, Ky., 620 miles; from Blacksburg, S. C., to Augusta, Ga., 140 miles, and from Lancaster, S. C., to Charlotte, N. C., 40 miles—a total of 800 miles. On Feb. 13, 1888, the company was empowered by the Kentucky legislature to consolidate with the Chattaroi (now Ohio & Big Sandy) R. R. Co., owning a railroad from Ashland to Richardson, Ky., 50 miles, or to build an independent line to the Ohio River. On March 28, 1888, a consolidation was effected with the Ohio, Kentucky & Virginia R. R. Co., owning a line from Richardson to White House, Ky. The company met with financial reverses, and on Dec. 10, 1890, a receiver was appointed in North Carolina and South Carolina; on Dec. 26, 1890, in Tennessee, and on Feb. 20, 1891, in Kentucky. Subsequently different divisions of the road were sold at sheriff's sale and bought in, for the most part, by the Finance Co. of Philadelphia, which held large claims against the original company. Negotiations which led to the sale, noted above, have been pending for some time, the Philadelphia people and Pres. Hunt having personally gone over the entire length of the road. It is stated that the road will by autumn be completed to Ironton, O. From this point it will be pushed to Portsmouth, where a junction will be made with the Cincinnati, Portsmouth & Virginia. As the two roads are owned by one company, they will be consolidated, which will complete the entire line, and connect Ashland, Ky., and Charleston, S. C.

KANSAS CITY, PITTSBURG & GULF.—The contract for building the extension from Pittsburg, Kan.,

to Joplin, Mo., 25 miles, has been let to Bernard Corrigan, the work to be completed in four months.

Projects and Surveys.

ROARING CREEK & CHARLESTON.—Chartered in West Virgina to build a railway from the mouth of Roaring Creek, in Randolph Co., to Charleston, W. Va. Among the incorporators are: W. F. Diller, Lancaster, Pa.; O. C. Womelsdorf, Pottsville, Pa., and Daniel P. Baker, Beverly, W. Va.

Northwest.—Existing Roads.

GULF, BEAUMONT & KANSAS CITY.—It is stated that this company, noted in our issue of March 30, has secured the money necessary to build 75 miles of its line. John H. Kirby, Houston, Tex.

DAKOTA, WYOMING & MISSOURI RIVER.—A press dispatch states that work will be resumed on the further extension of this road which is projected from Rapid City, S. Dak., west. The track materials for five miles more of the road are on the ground. W. T. Coad, Pres., Rapid City, S. Dak.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—L. M. Davis, Prin. Asst. Engr., Minot, S. Dak., writes us as follows regarding the extension of this railway through North Dakota, known as the Minot Extension: The extension will be 181 miles long and will run from Cathay, N. Dak., via Minot and Burlington, to the foot of Des Lacs Lake. All but 28 miles has been surveyed and 32 miles of the line were graded last season. A small force is now engaged on the bridgework, and grading will be resumed soon. It is expected to begin tracklaying by May 15. The contractors are Linton & Co., Minneapolis, Minn., who are to do the grading, bridging and all work necessary preparatory to beginning tracklaying. The earthwork will average 16,000 cu. yds. per mile. Maximum curve 4°; maximum grade west 0.8%, east 0.6%.

OHIO & MISSISSIPPI.—A press dispatch says: "The proposed extension of the Ohio & Mississippi Ry. from Beardstown, to Quincy, Ill., a distance of 40 miles, is the foremost theme of discussion here at the present time. The Baltimore & Ohio Ry. Co., in obtaining control of the Ohio & Mississippi Ry., has pledged a $2,000,000 improvement fund, a prominent feature of which is the extension from Beardstown westward. Several surveys have been recently made which pass through a rich farming country. The citizens of Beardstown have lately held meetings to look after the proposed extension, and the matter is now in the hands of the Business Men's Association, with instructions to lend all assistance possible in the matter of securing right of way through the city and land on which to build shops."

DULUTH, MESABI & NORTHERN.—Grading is about one-third completed on the extension from Columbia junction to Duluth, Minn., a distance of 28.9 miles. Wolf & King, of Duluth, are the contractors for the grading, and Morris & Shipley and R. and D. Lang, of West Duluth, for the bridgework. The extension will have maximum grade of 20 ft. to the mile to within 5 miles of Duluth and a maximum curvature of 4°. On the last 5 miles into Duluth the maximum grade is 2%. The last 5 miles will be double track with 80 lb. steel rails. A double track viaduct 4,000 ft. long is being built at Duluth for an approach to the ore dock. The Youngstown Bridge Co. has the contract for this work. The road has built 5 miles of spurs among the iron mines in the Mesabi range since Jan. 1.

Projects and Surveys.

CHICAGO & TEXAS.—Chartered in Illinois with a capital stock of $2,500,000.

CHICAGO, CASCADE & WESTERN.—Chartered in Iowa to build a railway from Dubuque, Ia., to a connection with the Chicago & Northwestern Ry., in Linn Co. Capital stock, $1,000,000.

RICE LAKE, DALLAS & MENOMINEE.—Arrangements are nearly completed for beginning work on the portion of this proposed railway between Rice Lake, Wis., and the Minneapolis, St. Paul & Sault Ste. Marie Ry. It is expected to have this section completed by June 1.

Southwest.—Existing Roads.

SHERMAN, SHREVEPORT & SOUTHERN.—It is stated that at a stockholders' meeting to be held in Greenville, Tex., on May 26, the question of borrowing $6,000,000 will be considered. The money is to be used for "acquiring and paying for its line of railway extending from Jefferson in Marion county, Tex., to McKinney, in Collin county, Tex., heretofore known as the East Line & Red River R. R., and to complete, improve and operate the same, and for constructing, completing, improving and operating certain extensions and branch lines of said railway which are proposed and intended to be hereafter constructed, as provided for in its articles of incorporation. It is designed to issue and dispose of its bonds for said amount, of $6,000 000 to be so borrowed, and as security for the payment thereof execute a mortgage on the property and franchises of the company, including the proposed extensions and branches to be hereafter constructed."

PORTLAND, MONTEREY & GULF.—Work is now in progress grading the transfer, at Portland, Tex., preparatory to making connection with the San Antonio & Aransas Pass R. R. Five miles of the grade are now completed and tracklaying will commence as soon as the material arrives. The engineering corps will commence at the end of the present grade and run another line to the Nueces River, near Sharpe, Tex.

Projects and Surveys.

SPRINGFIELD, SEDALIA, MARSHALL & NORTHERN.—A press dispatch from Sedalia, Mo., dated April 14, says: "Dwight Tredway, of St. Louis, was in this city to consult with J. B. Quigley, general contractor, for the construction of the Springfield, Sedalia, Marshall & Northern Ry., and O. A. Crandall, President of the road. It was decided to commence the construction of the road along the right of way in this city April 17. Mr. Emerson, formerly Chief Engineer of the St. Louis, Kansas City & Colorado, from St. Louis to Union, Mo., has been appointed Chief Engineer of the road, and will arrive in this city the first of next week. Work will be commenced at Springfield as soon as the right of way is secured through that city."

TEXAS, SABINE VALLEY & NORTHWESTERN.—The locating surveys are now in progress for the line from Carthage to Center, Tex., 30 miles. The earthwork will average 16,000 cu. yds. per mile; maximum grade 52.8 ft. per mile, maximum curve 3°. Gen. Man., R. J. Evans, Longview, Tex.

Rocky Mountain and Pacific.—Existing Roads.

SPOKANE FALLS & NORTHERN.—The contract for building the Nelson & Ft. Sheppard Ry., from the International line to Nelson, B. C., has been let to Peter Larsen, of Helena, Mont. The contract price is between $750,000 and $800,000, and the road is to be completed by Oct. 1.

CHICAGO & NORTHWESTERN.—A press dispatch from Salt Lake City, Utah, says: "It is said that contracts have been let for the grading of between 200 and 300 miles of extension of the Chicago & Northwestern Ry. from Fort Casper, Wyo. For the past four or five days several contractors from the Coast have been in Ogden looking after contracts. The contracts so far let have been mostly in sections, which is doubtless done for the purpose of facilitating the work and getting the roadbed in condition at the earliest practicable moment. In the negotiations for these grading contracts it is said the contractors dealt directly with the Chicago & Northwestern Ry. Co. through its agent, although the work is being done under the name of the Utah & Wyoming R. R. Co."

NORTHERN PACIFIC.—At a recent meeting of the stockholders the charter of the Burrard Inlet & Fraser Valley R. R. Co. was formally transferred to the Northern Pacific. At the same meeting the following officers were elected: Pres., C. D. Rand; Vice-Pres., Percy Dickinson, Tacoma; Treas., H. S. Hudson, Tacoma; Ch. Engr., J. Q. Barlow, Tacoma; Secy., D. S. Walldridge, Vancouver; solicitor, A. J. McColl, Vancouver. Mr. Hudson, speaking of the new road, is quoted in a Tacoma paper as saying:

"The complications are now past and the Northern Pacific will get from Vancouver the promised subsidy for building the Sumas-Vancouver railroad. It is a very good piece of road to build, the chief difficulty being the bridging of the Fraser River. The line is to extend from Sumas, Wash., to Vancouver, B. C., a distance of about 52 miles. Most of the line will be comparatively easy to construct, but from Vancouver to a point 8 miles east of New Westminster there is a good deal of rough ground. It is heavily timbered and it is rolling country. We have had surveying parties out, but they have been obliged to give up work on account of the snow. We are buying the right of way now, however, and shall proceed as rapidly as possible. We hope to finish the line within this year. Work may run on into February, but we hope to get through before. We shall work a force of about 500 men. All work is to be done under the supervision of the Northern Pacific. There will be a 2,300-ft. bridge on the line across the Fraser River. We shall build the bridge, but shall probably procure the material from the Dominion Bridge Co., of Montreal. The entire cost of the road will be fully $1,000,000.

Foreign.

BAROTEAN MUSQUES.—The survey of this railway, which will extend from Barotean, on the Mexican International Ry., to the Santa Rosa mining camp, in the State of Coahuila, has been completed, and the work of grading the new line has begun. The road will open up one of the richest mineral districts in northern Mexico. The new smelter at Santa Rosa has been completed and will begin operations as soon as the railway is finished.

METROPOLITAN BELT RY. CO.—This company, which secured a concession some months ago to build a belt railway around the City of Mexico, is making arrangements to begin construction. Geo. Fritch, Pres., Denver, Colo.

ELECTRIC RAILWAYS.

PETERBORO, ONT.—The Canadian General Electric Co., which recently received the town franchise for an electric street railway, has amalgamated with the Peterboro & Ashburnham Ry. Co., under the charter of the latter, for the purpose of constructing and operating the road. The officers are: T. E. Bradburn, Pres.; Frederic Nicholls, Vice-Pres.

GLOUCESTER, MASS.—William H. Jordan, W. Frank Parsons, David S. Presson, Henry W. Peabody and Lamont G. Burnham, their associates and successors, have chartered the Gloucester, Essex & Beverly St. Ry. Co. to construct and operate a railway in the city of Gloucester and the towns of Manchester, Essex, Wenham, Hamilton, Ipswich and Beverly.

MILLBURY, MASS.—Thomas M. Babson, Francis A. Harrington and James W. Stockwell have chartered the Millbury, Sutton & Douglas Electric R. R. Co., to locate, construct, maintain and operate an electric railway from some convenient point at or near the Blackstone River, in said Millbury, southwest to Sutton; thence south via the villages of Manchaug and East Douglas, to a point at or near the depot of the New York & New England R. R. in Douglas, with the right to construct a track to West Sutton.

NORTHAMPTON, MASS.—The Holyoke St. Ry. Co. has been authorized to extend its routes and tracks into the cities of Northampton and Chicopee.

CANANDAIGUA, N. Y.—The governor has signed a bill authorizing the Canandaigua Electric Light Co. to acquire the franchise of the Canandaigua St. R. R. Co., and operate it by electricity.

ORANGE, N. J.—The Suburban Traction Co. that was formed by the consolidation of the Orange Crosstown & Bloomfield Ry. Co. and the Orange Valley St. Ry. Co. has been formerly organized and articles of incorporation filed. The following are the officers: Pres., Frank W. Child; Treas., A. P. Foster; Secy., A. W. Kissam.

ALLENTOWN, PA.—A stock company has been formed, and a 999-years charter obtained for an electric street railway to connect twelve towns in Eastern Pennsylvania, beginning at Allentown and running to Easton. The towns in the circuit are Allentown, Fullerton, West Catasaqua, Catasaqua, Hokendagua, Copley, South Allentown, Aneyville, South Bethlehem, West Bethlehem, Bethlehem and Easton. The railway will run through the principal streets of each place, and will, through a large portion of its length, be a double-track line. Mr. Willis B. Hale, of Cleveland, O., is organizing a syndicate to build the line.

GLADWINE, PA.—Chartered, Gladwine Electric Ry. Co.; capital stock, $12,000; Richard Hamilton.

PHILADELPHIA, PA.—Chartered, Delaware & Schuylkill Ry. Co.; capital stock, $50,000; Pres., Henry C. Forrest.

WINTON, PA.—Chartered, Mt. Vernon Electric St. Ry. Co.; capital stock, $24,000. Pres., John Wood.

PHILADELPHIA, PA.—Permission to introduce the trolley system has been granted by the city councils for every block of track in the city. The aggregate mileage of track is nearly 500, and all the companies are preparing to push the work of installing the new system of motive power. Even the two cable roads are to be equipped with the trolley. The Philadelphia Traction Co., which was the first to receive the privilege, has made contracts for the reconstruction of its whole system, which aggregates about 200 miles of track. This company started the first trolley road in the city last fall, in Catherine and Bainbridge Sts. The work of laying new rails has been begun by the company on three other lines, and it expects to have as many as six lines, including the two cable roads, operated by electricity by October. The People's Traction Co. was organized early this year with a capital of $10,000,000, to install the trolley system on the roads operated by the People's Passenger Railway Co. It purchased the stock of the latter corporation, and has announced its intention of equipping the lines with electric motors without delay.

DOVER, DEL.—The Kirkwood & St. George's Electric Ry. bill has passed both houses of the Delaware legislature. The incorporators are authorized to construct their railway from Kirkwood via St. George's and Delaware City to Augustine Beach. The house has passed the Smyrna & Woodland Beach Electric Ry. bill. A new bill for a railway from Gordon Heights to Wilmington has been introduced in the House.

BALTIMORE, MD.—All franchises and rights of way have been secured or are guaranteed, it is said, for an electric railway between Baltimore and Washington, and construction work will begin at an early date. The road is to be 38 miles long. Capital to the amount of $1,500,000 has been subscribed, it is said, to carry out the project. It is understood that Alexander Brown & Sons, bankers, of Baltimore, are in the enterprise, along with others of the same city; and the Elliotts, prominent bankers of Boston, and two New York capitalists. The Boston and New York people and the Browns furnish the bulk of the capital, and their representatives will have charge of the construction. This enterprised is not connected, it is said, with the Traction Co.'s projected road between Baltimore and Washington. The officers elected are: Pres., George Yakel; Vice-Pres., Carl Schon; Treas., Victor G. Bloede, and Secy., Henry J. Berkeley. The company will work under the charter of the Baltimore, Catonsville & Ellicott City Electric R. R. Co.

BRANDYWINE SPRINGS, MD.—The Delaware Senate has passed the Brandywine Springs Electric Ry. bill. The bill gives the right to construct a railway from Brandywine Springs to the northwestern boundary line of Wilmington.

ELLICOTT CITY, MD.—Judge I. Thomas Jones, of Howard County Circuit Court, has signed the certificate of incorporation of the Ellicott City & Clarksville branch of the proposed electric railway from Baltimore to Ellicott City. The incorporators are State Senator John G. Rogers, Harper Carroll, John F. McMullen, John L. Clark and John H. Owings. The capital stock is $200,000. The corporation is formed for 40 years.

DAYTON, O.—The Dayton St. R. R. Co. asks permission to extend its tracks on a large number of streets in the city. The plan, as projected, involves the building of 20 miles of new tracks, and will form a system comprising in all 30 miles.

MUNCIE, IND.—The Muncie Belt R. R. Co. has been organized with the following officers: J. F. Darnell, Pres.; R. J. Beatty, Vice-Pres.; F. C. Ball, Treas.; Geo. O. Cromwell, Secy. The road is about two miles long, and is nearly completed.

TALLAHASSEE, FLA.—The city council has passed an ordinance giving the Tallahassee St. Ry. Co. the right to construct and operate the trolley system for electric cars.

GALLATIN, TENN.—The proposal for an electric car line from this place to Nashville has been renewed. The Nashville Turnpike Co. has been purchased by a corporation of capitalists who say that they will convert the old pike bed into an electric car track, and that they will have the line in full operation by the first of June. The corporation is composed of some of the rich men of the county, and among the number are Col. Horacio Berry, George Seawright and Robert Groves, of Hendersonville.

CHICAGO, ILL.—An ordinance has been granted to the Chicago Electric St. Ry. Co. to construct and operate street railways on a large number of streets.

GOLDEN, COLO.—The county commissioners have granted a franchise to the Denver, Lakewood & Golden R. R. Co., to construct a road from their present line along Sheridan Boulevard to a junction with the West End electric, on West Colfax Ave.

HORSE AND MOTOR RAILWAYS.

BEAVER FALLS, PA.—Chartered, Allegheny Valley St. Ry. Co.; Parnassus to New Kensington, Pa.; capital stock, $15,000; Pres., John C. Whittle.

PITTSBURG, PA.—Chartered, Allegheny Connecting Ry. Co.; Pittsburg along Allegheny Valley River; capital stock, $10,000; Pres., Geo. T. Oliver.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The ordinance granting the Chicago Midland Rapid Transit Co. the right of way for an elevated railway over several streets in this city, has passed the city council.

KANSAS CITY, KAN.—An ordinance will be introduced at the next meeting of the city council granting a franchise to the Elevated Ry. Company to extend its line to Argentine. Since its reorganization the company has decided to make some improvements, and one of the first things to be done now is get a line into Argentine. The new extension will commence at Seventh and Kansas Ave. in Armourdale, and run west to Pyle St., thence south to Miami Ave., thence west to the Argentine Boulevard. From there it will run over the boulevard and Argentine bridge to the limits of Argentine. An ordinance will also be introduced in the council at Argentine asking for a franchise to construct and operate the road on some of the principal streets in the "bottoms."

BRIDGES, TUNNELS AND CANALS.

NEW BEDFORD, MASS.—A bridge to cost not exceeding $20,000 is to be built across the tidal waters

of the east branch of Westport River connecting Horseneck and Westport Point.

TROY, N. Y.—The governor has signed the bill incorporating the Troy & Green Island Bridge Co., which proposes to build a bridge across the Hudson River from Green Island to Douw St., North Troy.

ALLEGHENY CITY, PA.—Petitions are being circulated in Pittsburg and Allegheny for general signature praying that the county build a free bridge across the Ohio River at the foot of Locust St., Allegheny.

SALEM, MASS.—The Common Council is considering the appropriation of $20,000 for a new draw at the Union bridge.

PHILADELPHIA, PA.—The Bureau of Surveys has completed plans for a new bridge at Gray's Ferry. The plans provide for a double-decked iron drawbridge with a span of 325 ft. On the upper deck will be the wagon driveway, and on the lower the railway tracks. The upper deck is to be 55 ft. and the lower 35 ft. above the water.

LAWRENCE, MASS.—The Boston & Maine R. R. will replace its present bridge over the Merrimac River near Broadway with a four track plate girder bridge.

TACOMA, WASH.—The ordinance providing for the issuing of bonds to the amount of $110,000 for the building of the Eleventh St. bridge of Tacoma has passed the council.

CASTORLAND, N. Y.—The state has appropriated $10,000 for rebuilding the two-span bridge at this place and a drawbridge at Greig.

NIAGARA FALLS, N. Y.—It is stated that preparations are being made to build a bridge across the gorge of the Niagara River below the present suspension bridge. The bridge, it is stated, will provide for two railway tracks for the Grand Trunk Ry. and a wagonway. L. L. Buck, of New York, N. Y., is the engineer. There is probably little prospect of actual construction soon.

EVERETT, WASH.—Work on the tunnel for the Great Northern in this city was begun on April 1. It will be 2,400 ft. in length and will probably take six months or more in its construction. It runs under the hill from the center of town to a connection with the Seattle & Montana shore line on the bay side.

HIGHWAYS.

NEW YORK.—The town of Hempstead has appriated $120,000 to macadamize the main thoroughfares of the town.

CALIFORNIA.—Plans have been prepared for a new highway between Kernville and Bakersfield. The estimated cost includes 17 miles of grading at $750 per mile and $5,000 for two bridges.——A new county road between Alameda and San Leandro is projected by the Alameda Improvement Association, and the estimated cost is $10,000.

WASHINGTON.—The Chehalis-Newankum Plank Road Association was organized last year and built four miles of plank road from Chehalis. It is reported that 2½ miles of additional road will soon be constructed.

WATER-WORKS.

New England.

BANGOR, ME.—C. L. Collamore is on a committee to engage a competent engineer to report on the needs of the pumping plant and distributing system.

NEWPORT, ME.—The Newport Water Co. has organized with A. I. Harvey, Pres., and C. H. Merrill, Treas.

NEWMARKET, N. H.—The people have voted 147 to 139 against building works.

BOSTON, MASS.—Bids are wanted by the water board until April 29 for building filter beds at Natick for the purification of the waters of Pegan Brook, before they enter Lake Cochituate. There will be approximately 10,000 cu. yds. of earth excavation, 600 sq. yds. of rip-rap, 100 cu. yds. of rubble masonry, 800 cu. yds. of concrete, 8,3 M. ft. B. M. of tongued and grooved sheet piling. Wm. Jackson, Cy. Engr.

CHESTER, MASS.—A survey for works is being made.

IPSWICH, MASS.—Geo. Fall and Wm. Roberts are on a committee just appointed to investigate a water supply.

OAKDALE, MASS.—The people have voted to petition the legislature for authority to build works.

VINEYARD HAVEN, MASS.—Bids are wanted until April 28 for constructing a filter gallery 12 × 75 × 12 ft. deep from the finished top of side walls. E. Worthington, Jr., & Co., Engrs., 53 State St., Boston; A. F. Cummings, Supt. Vineyard Haven Water Co.

WEBSTER, MASS.—The town has received authority by legislative act to build works and to issue $100,000 of bonds, provided it first purchases the works now owned by H. N. Slater.

BRANFORD, CONN.—A water company is reported as formed by New Haven men; Secy. and Treas., W. S. Pardee. It is proposed to pump water from Twin Lake to a 25 × 65 or 80-ft. stand-pipe.

MILFORD, CONN.—A bill to incorporate the Milford Water Co. is before the legislature; Geo. M. Gunn, Henry A. Taylor, and others.

NEW LONDON, CONN.—A reservoir and supply main to furnish water for manufacturing purposes are proposed.

UNIONVILLE, CONN.—It is reported that this place will have works.

Middle.

CORINTH, N. Y.—Surveys for gravity works are being made for a company in which J. J. Dunn and H. P. King, Glens Falls, are interested.

COXSACKIE, N. Y.—Works are talked of again.

EDWARDS, N. Y.—Works are projected.

SCHENECTADY, N. Y.—It is reported that a 10,000,000-gallon pumping engine will be added and other improvements made.

SYLVAN BEACH, N. Y.—B. J. Spencer, Sylvan Beach, Seth D. Baldwin, Oneida, and others propose to organize a company to build works.

WINDHAM, N. Y.—Works are projected.

JERSEY CITY, N. J.—Specifications have been prepared by Chf. Eng. W. W. Ruggles for a 48-in. cast iron pipe line 30,280 ft. long, from the Belleville reservoir No. 1, to the city reservoirs Nos. 2 and 3. There will be about 1,080 ft. of submerged pipe with the J. F. Ward adjustable joint. Some of the pipe will be laid on capped piling. Bonds are proposed to meet the expense, estimated at $650,000.

COCHRANTON, PA.—May 8 the people will vote on building works; estimated cost, $9,600.

ELIZABETH, PA.—Works are talked of.

JOHNSTOWN, PA.—It is reported that a company is being formed to supply East Conemaugh and Franklin borough; Pres., Robt. Nix; Secy., J. J. Shaffer; Engr., E. A. Cresswell. The proposed source of supply is Clupboard Run, about 1½ miles from Conemaugh.

LEBANON, PA.—The Lebanon Water Co. has voted to increase its capital stock, and proposes to extend its mains into the townships of North and West Lebanon, it is reported.

LITITZ, PA.—The people have voted 146 to 5 for works, and 114 to 32 in favor of allowing the Lititz Water Co. to build them.

McKEE'S ROCKS, PA.—There is talk of works; estimated cost, $25,000 to $50,000.

SOMERSET, PA.—Bids for works are wanted by the borough; pumping and gravity systems may be bid on.

PENNSYLVANIA.—The following companies have been incorporated, each with a capital stock of $1,000, and with Geo. W. Childs and A. J. Drexel, Philadelphia, interested, and with Philadelphia as the principal place of business: Millbrook Water Co., Haverford; Skippack Water Co., Lower Providence; St. David's Water Co., Radnor; Stafford Water Co., Tedyffrain; Devon Water Co., Eastboro; Elm Water Co., Lower Merion; Valley Forge Water Co., Upper Merion. The Quakertown Water Co., of Quakertown, has also been incorporated; $1,000. Mr. A. H. Steinboocher, 2,007 Memphis St., Philadelphia; also the East Brady Water Co., East Brady; $12,000; E. S. Wallace.

Southern.

PETERSBURGH, VA.—The council has appropriated $10,000 for a new dam about 17 ft. high, designed to store 70,000,000 gallons; $15,500 for a distributing reservoir; $2,500 for a 100-HP. Corliss engine; $5,000 for a new force main; all the work to be done under the direction of Cy. Engr. John W. Hays.

ONEONTA, ALA.—It is reported that works will be built

THIBODAUX, LA.—W. T. Covel, Biloxi, Miss., has made a proposition to put in works.

North Central.

HILLSBORO, O.—The people have voted 700 to 48 for works.

LEBANON, O.—May 2 the people will vote on building works.

LOCKLAND, O.—It is expected that $20,000 will be spent for works soon. Vil. Atty. F. Gorman having reported the election legal at which the above sum was voted.

READING, O.—The contract for pipe in place, hydrants and boxes has been awarded to Dimick & Co., Newport, for $13,475.

PORTLAND, IND.—It is reported that in case the city will annul a franchise, on the ground of non-compliance, granted some time ago to Gardiner & McGlasson, Ashland, Ky., that John M. Smith, John Hayes and others will build works.

SOUTH BEND, IND.—Estimates have been made calling for about $28,000 of pipe and pipe laying.

LOWELL, MICH.—It is reported that works are projected and that a contract for test wells has been made.

BERWYN, ILL.—The town board of Cicero has decided to extend the Berwyn system to supply Morton Park, La Vergne and Hawthorne, which will complete the supply of the south part of the town, it is said.

CHICAGO, ILL.—A contract for a 1,000-ft. extension to the 68th St. intake tunnel has been awarded to Schuller & Schingtan for $14,816.

BERLIN, WIS.—The people have voted for works.

KAUKAUNA, WIS.—It is reported that the contract for building works has been awarded to Moffett, Hodgkins & Clarke, New York city, for $56,000.

SOUTH MILWAUKEE, WIS.—It is reported that the new city council has rescinded the ordinance granting a franchise to C. E. Gray, Jr., & Co., Whitewater, and will advertise for new bids; also that such action was illegal.

Northwestern.

DES MOINES, IA.—It is reported that the company will lay a 20-in. main.

LAKE CITY, MINN.—The people have voted in favor of works.

OSAWATOMIE, KAN.—Works are still under discussion.

BANCROFT, NEB.—Bonds to the amount of $7,000 have been voted for works.

DILLON, MONT.—The people have voted 210 to 38 in favor of issuing $50,000 of bonds for works.

Southwestern.

BONHAM, TEX.—Works are projected.

EASTLAND, TEX.—Efforts are being made to secure works.

WAXAHACHIE, TEX.—It is reported that Mayor Du Bose will try to introduce works. We understand that a company built works in 1891.

EDMOND, OKLA.—Works are projected.

FLORENCE, COLO.—A vote for works has been cast, the majority being twelve. Mayor, J. A. McCandlers.

LOUISVILLE, COLO.—Town officials who favor the building of works have been elected; Mayor, Robt. Loch.

SILVER CLIFF, COLO.—The people have voted to authorize the town trustees to arrange for works. Address Mayor Haskell. Works were built in 1880 by a company, turned over to the bondholders in 1886 and shut down early in 1889.

Pacific.

SUMNER, WASH.—It is reported that the people will soon vote on building works with a supply from a spring 6,000 ft. from the center of the city.

TACOMA, WASH.—It is reported that the city has voted by a small majority to buy the works of the Tacoma Light & Water Co.

ASTORIA, ORE.—Plans for new works are being made by Adams & Gemmel, Pendleton.

WESTON, ORE.—The sum of $10,000 has been voted for extensions.

SANTA ROSA, CAL.—May 9 the people will vote on issuing $165,000 bonds for works. A company furnishes a supply.

ARTESIAN WELLS.

SOUTHAMPTON, PA.—It is reported that a number of farmers propose to sink wells.

SEWERS.

BRUNSWICK, ME.—Thos. H. Riley, Village Clk., informs us that a committee has been elected to procure plans and estimates for a sewerage system and to report at a meeting to be held June 1.

ROCHESTER, N. H.—We are informed by C. S. Barker that bids will be opened next month for 11 miles of pipe sewers, average cut 10 ft., estimated cost $100,000.

BRAINTREE, MASS.—The question of adopting a system of sewerage is being considered by the council.

EVERETT, MASS.—The legislature has authorized the issue of the proposed $125,000 of sewer bonds.

HOLYOKE, MASS.—Plans have been completed for the systems for Elmwood and Oakdale. There will be about 4,000 ft. of 10-ft. sewer, and 7,000,000 brick will be required for the construction. D. L. Farr, mayor.

LAWRENCE, MASS.—The city engineer has plans and specifications nearly completed for a sewer in Water St. to cost $50,000.

WEST NEWTON, MASS.—Bids are asked until May 5 for 200,000 ft. of 4 to 20 in. salt glazed vitrified sewer pipe, 4,000 bbls. of American cement, 1,000 bbls. of Portland cement, and 250 cast iron manholes; also for building sections 6 and 8 of the Newton sewer system. Albert F. Noyes, Cy. Engr. See advertisements.

EAST GREENWICH, R. I.—S. M. Knowles, C. G. Hill and W. A. Hanaford have been elected as sewer commissioners.

MERIDEN, CONN.—An appropriation of $50,000 has been voted for section 6 of the sewer system.

DUNKIRK, N. Y.—Plans have been prepared for a brick sewer to cost $15,000 or $17,500, according to the route selected.

FONDA, N. Y.—The water commissioners have had surveys made for a sewerage system.

KINGSTON, N. Y.—Edwin B. Codwise, Cy. Engr., informs us that plans are being prepared for a system of sewers in wards 2 and 9.

NIAGARA FALLS, N. Y.—The contract for 5,018 lin. ft. of 8-ft. trunk sewer, in tunnel at a depth of 45 ft., has been awarded to Chas. Donoghue & Co., Chattanoogn, Tenn., at $122,000. The itemized bids were published in our issue of last Dec. 8.

ROCHESTER, N. Y.—Contracts have been awarded as follows: E. C. Lauer, at $31,792, estimate $46,500; Whitmore, Rauber & Vicenus, at $8,395, estimate $10,880.

SARANAC LAKE, N. Y.—Goff & Taylor, Malone, have been awarded the contract for sewers at this place.

STAMFORD, N. Y.—It is reported that the contract for a sewer system has been awarded to Mitchell & Morgan, Kingston.

MOORESTOWN, N. J.—At a special town meeting April 12 it was decided to establish a system of sewerage.

WASHINGTON, D. C.—The district commissioners will receive bids until May 27 for a main intercepting sewer from the Potomac River, near Easter's Point, to near the intersection of Fifteenth and E Sts. Northwest.

NEW ORLEANS, LA.—Dr. Joseph Holt, Pres., New Orleans Sewerage Co., organized about a year ago to construct a system of sewers in this city, reports that the work of construction will soon be commenced. Geo. G. Earl is resident Chief Engineer, and Mat. B. M. Harrod, is resident Consulting Engineer. Rudolph Hering and Geo. E. Waring, Jr., New York, are Consulting Engineers.

VICKSBURG, MISS.—At a special meeting of the city council April 11, local capitalists submitted plans for a separate system of sewers, to cover the western watershed of the city, comprising the business streets and half of the population, taking in payment for the system the $100,000 in 6% bonds authorized by the legislature. The proposition is under consideration.

NASHVILLE, TENN.—Bids will be received until May 16 for sections A, B, C, D and E of the Lick Branch sewer, separate bids to be received on each section; estimated cost, $350,000. Sewer bonds for $400,000 have been sold.

LOUISVILLE, KY.—Rudolph Hering, New York, has completed his report on the sanitary condition of the city, for the Commercial Club. He finds 63 miles of sewers in the city, the discharge being into the Ohio River. Extensions of the system are recommended to all streets having vaults, and connections made with every house. The valley of Beargrass Creek should be improved by building a sewage interceptor to prevent foul matter from entering the creek. A system of regular inspection is urged.

CINCINNATI, O.—Bids have been received for $200,000 of sewer bonds.

DAYTON, O.—Plans are being prepared by Cady Stanley and Geo. S. Pierson, Kalamazoo, Mich., for a separate system of sewers for sewer district No. 8.

KOKOMO, IND.—The city clerk will receive bids until May 1 for a 15-in. sewer in one street.

DELAVAN, ILL.—The business men are urging that the city council obtain estimates of the cost of a suitable sewer system.

DES MOINES, IA.—The board of public works has been directed to advertise for bids for several 12 to 24-in. pipe, and 36 to 42-in. brick sewers.

ST. CHARLES, MO.—We are informed that an extensive and modern sewer system is to be established. A proposition has been received from the Lewis-Mercer Construction Co., New York, as noted in our issue of March 16.

WESTPORT, MO.—The question of a sewer system was defeated by a small vote at the late election, and the question will be voted upon again within a few weeks.

OMAHA, NEB.—The city engineer has been instructed to submit plans and estimates of such main sewers as can be immediately constructed within the

limits of funds available for such work. Sewer bonds for $100,000 will soon be sold.

PASO ROBLES, CAL.—Ernest Trevor, Cy. Engr., informs us that nothing has been done for sewers except to appoint a committee of investigation. The issue of sewer bonds for $60,000 is proposed, as noted in our issue of April 6.

SACRAMENTO, CAL.—We are informed by J. C. Boyd, Cy. Engr., that plans are being prepared for a new sewerage system.

KALISPEL, MONT.—It is reported that plans for a system, prepared by C. B. Davis, Chicago, Ill., will be submitted to the taxpayers in a few weeks.

SEATTLE, WASH.—The chamber of commerce has petitioned the city council to submit to the people a propsition to issue sewer bonds for $250,000 to commence the construction of a permanent sewerage system.

TACOMA, WASH.—James M. Morrison, Cy. Engr., informs us that an election will be held May 9 to vote on the issue of bonds for $500,000 for sewers. No definite plans or specifications have as yet been prepared for the big sewer, which will be of brick, 5 to 6-ft. in diameter, 22,000 ft. long, and cost about $450,000.

STREETS.

NORTH ATTLEBORO, MASS.—The road commissioners have decided to lay brick paving on one street, as an experiment.

ALBANY, N. Y.—The board of contract will receive bids until May 1 for paving four streets with dimension granite blocks.

NEW YORK, N. Y.—The commissioner of public works will receive bids until April 25 for eight contracts for granite block paving. The park commissioners will receive bids until April 26 for about 12,000 sq. yds. of asphalt paving, 11,000 sq. yds. of macadam paving, etc.

PHILADELPHIA, PA.—Bids will soon be asked for a large amount of paving. The director of public works hopes to get the alleys and small streets paved with asphalt before hot weather comes.

MEMPHIS, TENN.—The board of fire and police commissioners will receive bids until April 27 for paving Jefferson St. with vitrified brick.

LOUISVILLE, KY.—W. F. Shanks has been awarded the contract for paving Baxter Ave. with granite blocks, at about $20,000.

DAYTON, O.—Contracts for paving were awarded April 14, as follows: Trinidad Asphalt Paving Co., at about $11,000 for asphalt; Berry & Davis, Bellaire, at about $42,000 for Canton brick; M. G. Cain & Co., Dayton, at about $20,000 for Canton brick and $5,400 for Medina blocks.

IRONTON, O.—The following bids were received for the improvement of Adams and Third Sts.: T. J. Mulligan, $34,468; P. H. Kelly, Portsmouth, $31,506; W. F. Patterson, Roanoke, Va., $41,562; J. J. Shipton, Shawneetown, Ill., $39,424; B. D. Barton, Port Huron, Mich., $37,742; H. C. Babbitt, Columbus, $40,000; Berry & Davis, Bellaire, $32,505; A. C. Pugh & Co., Columbus, about $39,000; Maloney Bros., Bellaire, $30,412; H. M. Francisco, Ironton, $23,069.

LANCASTER, O.—The contract for paving East Main St. has been awarded to McNaughton & Pesido, at $25,889.

MANSFIELD, O.—Additional paving has been ordered.

PORTSMOUTH, O.—Bids will be asked in a few weeks for 20,380 sq. yds. of vitrified brick paving, with sandstone curbing; length of streets, 3,234 ft.; estimated cost, $40,650. R. A. Bryan, Cy. Engr.

RIVERSIDE, O.—The village clerk will receive bids until April 25 for grading, macadamizing, sewering, etc., in Maxwell Ave.

SAGINAW, MICH.—The city engineer reports that 5.64 miles of pavements were constructed last year at a cost of $42,542. The city has about 202.6 miles of streets, of which nearly 31 miles are paved.

CRAWFORDSVILLE, IND.—Bids will be received until May 1 for brick sidewalks in several streets. J. M. Waugh, Cy. Engr.

MUNCIE, IND.—The city clerk will receive bids until May 1 for about 20,000 sq. yds. paving with Trinidad Lake asphalt.

DECATUR, ILL.—The city council has ordered the immediate extension of several brick paved streets; estimated cost, $4 per lin. ft.

KANSAS CITY, MO.—The mayor has signed an ordinance providing for the construction of the proposed Independence boulevard.

ST. JOSEPH, MO.—Jule St. is to be paved with brick, from Sixth St. to the river.

ST. LOUIS, MO.—The board of public improvements will receive bids until May 6 for several street improvements, including the paving of two avenues with asphalt.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Brick masonry, 4,250 cu. yds., at	$8.55	$7.70	$6.00	$7.00	$7.20	$7.00	$6.80	$9.50	$8.00
Stone " 1,300 " "	4.88	4.50	4.80	4.50	4.00	5.00	4.50	6.30	6.00
Concrete " 1,200 " "	2.80	4.00	3.60	4.50	2.75	5.25	4.50	4.00	3.75
Excavation, 7,750 cu. yds., at	.28	.20	.24	.20	.20	.40	.25	.40	.50
Backfilling, 15,000 " "	.16	.10	.24	.15	.10	.20	.25	.32	.20
Manholes, 16, at	18.50	20.00	25.00	30.00	31.50	25.00	25.00	30.00	25.00
Lumber, 20,000 ft, at	18.00	20.00	25.00	15.00	22.00	10.00	18.00	20.00	19.00
Iron pipe, laid, 5 tons, at	33.00	35.00	35.00	40.00	30.00	60.00	30.00	34.00	30.00
8-in. sewer pipe, laid, 100 ft., at	.23½	.30	.35	.13	.41	.23	.23	.40	.30
10 in. " " " 200 " "	.39	.35	.80	.19	.48	.30	.27	.40	.30
12-in. " " " 300 " "	.44	.40	1.35	.24	.52	.35	.32	.60	.40
15-in. " " " 200 " "	.55	.50	1.40	.35	.60	.48	.42	.80	.60
18-in. " " " 200 " "	.67	.65	1.80	.51	.95	.61	.47	.80	.60
Repaving, per sq. yd	1.25	.45	3.00	.18	.15	1.35	.10	.60	.60

OMAHA, NEB.—The city will soon sell the $200,000 of improvement bonds that were voted last fall.

OGDEN, UTAH.—Bids have been received for $100,000 of improvement bonds.

SACRAMENTO, CAL.—Plans have been prepared for 20,500 sq. yds. of paving with bituminous rock, with 1,500 lin. ft. of granite curbing; estimated cost, $45,500. J. C. Boyd, Cy. Engr.

ELECTRICAL.

JAMESTOWN, N. Y.—The proposition to increase the electric light plant will be submitted to a vote of the taxpayers on April 27.

HAGERSTOWN, MD.—The contract for 72 arc lights for street lighting has been awarded to Rodgers, Shanly & Co., New York, at $80 per light per year. This company was also awarded a franchise for an electric street railway, and the two will be operated together.

HYATTSVILLE, MD.—Dr. Chas. A. Wells and J. A. Blunden are interested in a new company that proposes to furnish incandescent lights at $12 each per year.

BUCHANAN, MICH.—It is reported that a municipal electric light plant is to be put in.

WESTPORT, MO.—An election will soon be held to vote on proposed electric light franchises.

WESTON, ORE.—The citizens have voted to issue bonds for $4,000 for electric lights.

NEW COMPANIES.—Crescent Electric Light Co., McKee's Rocks, Pa.; $25,000; Treas., Wm. J. Burns, Pittsburg. Sutton-Steele Electric Co., Dallas, Tex.; capital, $100,000; G. A. Ginocchio, Marshall; J. B. Lanere, Fort Worth; W. L. Steele, Dallas. Commercial Electric Supply Co., of St. Louis, Mo.; $15,000; W. F. Carter, H. D. Ames, M. A. Knapp. Mount Vernon Electric Light Co., Mount Vernon, Ill.; $20,000; A. C. Tanner, G. W. Evans, W. S. Arnold. Abatis Electric Mfg. Co.; Chicago, Ill.; $50,000; A. R. Hussey, Nelson Erickson, W. Newman. Economy Electric Co.; Chicago, Ill.; $1,500,000; G. A. Gage, A. C. Haveu, C. E. Potter.

MISCELLANEOUS.

SURVEYING, ETC.—Washington, D. C.—Bids are asked until May 6 for surveying and marking by suitable monuments that portion of the boundary line between the states of Nebraska and South Dakota, which lies west of the Missouri River. S. W. Lamoreux, Comr., General Land Office.

DAM.—Cincinnati, O.—Plans have been prepared for a dam to be built in the Allegheny River, at Herr's Island, and the work will soon be advertised. Maj. Amos Stickney, Supt. River Improvements.

GAS COMPANIES.—Oxygen Gas Co., Chicago, Ill.; $1,000,000; C. M. White, J. L. Devine, F. King.—Indiana Natural & Illuminating Gas Co., Indianapolis, Ind.; $1,000,000; C. F. Dierieche, E. C. Benedict, New York; J. R. Pearson, Indianapolis. This incorporation is the consummation of a deal for a consolidation of the artificial and natural gas companies of Indiana which was begun some months ago. The present incorporation includes the plants at Indianapolis, Crawfordsville, Lebanon and other places. It is intended to include Kokomo, Richmond, Rushville, Anderson and Muncie and other cities if possible.

CONTRACT PRICES.

PIPE.—Brockton, Mass.—The contracts for 16,000 ft., about 1,400 tons, of 24-in. cast iron pipe has been awarded by the sewerage commissioners to the Reading Foundry Co., Reading, Pa., at $27.33 per ton, the pipe to be ⅝-in. in thickness.

Martinsville, Ind.—The water-works committee has awarded the contract for pipe to the Addyston Pipe & Steel Co., Cincinnati, O., at $23.50 per ton for 400 tons of 6 to 10-in. pipe and 2.5 cts. per lb. for 20 tons of specials.

BRICK PAVING.—Monongahela City, Pa.—We have received from Geo D. Jenkins, Cy. Engr., a statement of the bids received for paving Main St. with brick, which were as follows: 1, grading, per cu. yd.; 2, paving on stone foundation with tar filling, per sq. yd.; 3, gravel foundation with tar filling; 4, stone without tar; 5, gravel without tar; 6, sandstone curbing, per lin. ft.

	1	2	3	4	5	6
	cts.	$	$	$	$	cts.
J. C. McSpadden, McKeesport	44	1.48	1.48	1.38	1.38	60
R. T. Hallam & Sons, Washington, Pa.	30	1.80	1.52	1.65	1.28	60
McCrady & Rosser, Braddock	30	1.65	1.43	1.45	1.23	57
Freshwater & Boren, Steubenville, O.	24	1.32	1.22	1.17	1.07	49
Purnell & Orr, Alleghenv	70	1.56	1.43	1.39	1.26	68
Keeling Ridge & Co., Pittsburg	35	1.75	1.50	1.60	1.35	75

Springfield, Ill.—Contracts for paving with brick have been awarded as follows: Henry Nelch, at $1.375 to $1.485 per sq. yd.; Rockford Construction Co., $1.31 and $1.40; E. C. de Frates, $1.84 for large Peoria brick.

SEWER.—Dayton, O.—G. B. Pike, Asst. Cy. Engr., sends us a statement of the bids received April 10 for a storm water sewer to drain about 800 acres. The contract was awarded to Chris Poock, the total bids being as follows: 1, B. D. Bartow, Port Huron, Mich., $32,025; 2, W. J. Gawne, Cleveland, $47,805; 3, Frank Whiteley, Springfield, $44,135; 4, Jno. Munger & Co., Dayton, $46,093; 5, Chris Poock, Dayton, $43,862; 6, Williams & Ulrich, Springfield, $50,111; 7, Bruno Ritty, Dayton, $47,108; 8, F. H. Kirchner, Cincinnati, $62,995; 9, David Folz & Sons, Cincinnati, $54,615; engineer's estimate, $53,000.

STREET SUPPLIES.—Troy, N. Y.—The following contracts have been awarded: W. E. Cheney, Rosendale cement, $1.30 per bbl.; Alexander Ferguson, brick, 80 cts. per 100; Patrick Fitzsimmons, cobble stones, $1 per load; sand, $1 per cu. yd.

GRANITE CURB AND BLOCKS.—Washington, D. C.—The district commissioners have received the following bids for granite curb: Geo. Pierce, 8×8 ins., 87 cts. and $1.19 per lin. ft. for straight and circular, respectively; 6×20 ins., $1.08 and $1.45; Acker & Co., 84.5 cts. and $1.30; and $1.58; A. W. Smith, 85 cts. and $1.15; $1.05 and $1.30; Brandywine Granite Co., 80 cts. and $1.43; 90 cts. and $1.43. The bids for 800,000 granite paving blocks were as follows: Booth Bros. and Hurricane Isle Granite Co., $49, $51, $52 and $53 per 1,000 for the first, second, third and fourth 200,000, respectively; Richmond Granite Co., $51 per 1,000; A. W. Smith, $50 per 1,000.

ASPHALT AND BRICK PAVING.—Dayton, O.—Contracts for paving with asphalt have been awarded: Trinidad Asphalt Co., Dayton, paving, $2.75 per sq. yd.; 24-in. curbing, 71 cts. per lin. ft.; total, $11,638. paving, $2.73; 24-in. curbing, 74 cts.; total, $23,885. Warren-Scharf Asphalt Paving Co., New York, paving, $2.75; 21-in. curbing, 70 cts.; total, $11,300; paving, $2.78; 21-in. curbing, 70 cts.; total, $21,756; paving, $2.76; 24-in. curbing, 75 cts.; total, $27,474. The contract for paving Wayne Ave. has been awarded to Ed. Ryan, Springfield, at $2.28 per sq. yd. for East Clayton brick. The itemized bids were published April 6.

PILE BULKHEAD.—Rock Island, Ill.—Bids were opened April 8 by Maj. A. Mackenzie, U. S. Engineer Office, for a pile bulkhead in Quincy Bay. The work is as follows: 1, white oak filing, in place, 20,000 lin. ft., per lin. ft.; 2, sheet filling, in place, 100,000 ft. B. M., per M. ft.; 3, walling, in place, 28,000 ft. B. M., per M. ft.; 4, gravel filling, in place, 4,000 cu. yds., per cu. yd.

	1	2	3	4
	cts.	$	$	cts.
C. I. McDonald, Pittsburg, Pa.	49	45.00	45.00	82
J. Truax, Hastings, Minn.	30	35.00	35.00	30
H. S. Brown, Quincy, Ill	..	....	....	30
Diver & Swanwick, Keokuk, Ia.	25	25.00	25.00	28
Van Sant & Lutes, St. Louis, Mo.	28	27.50	27.50	35
B. Gelatt, Columbus, Junc., Ia.	30	50.00	25.00	33½

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Brooks Locomotive Works, Dunkirk, N. Y., have orders for 5 eight-wheel engines with cylinders 17×24 ins. and driving wheels 6 ft. diameter, for the Lake Shore & Michigan Southern, to haul the new fast express to Chicago; the works have completed a fast passenger engine for the Cincinnati, Hamilton & Dayton, and have an order for 10 mogul engines for the New York, Lake Erie & Western. The Baldwin Locomotive Works, Philadelphia, Pa., are completing a number of engines, with cylinders 20×24 ins., for the Pittsburg Division of the Baltimore & Ohio, and are building a logging engine for the Shelton & Southwestern Ry., Washington. The Pittsburg Locomotive Works, Pittsburg, Pa., have an order for 14 eight-wheel and ten-wheel passenger engines and 2 switching engines. Wm. Brugh, Jr., Warren, Tex., wants a 20 to 30-ton locomotive, 3 ft. gage. The Caldwell & Northern R. R., Lenoir, N. C., wants two 18-ton locomotives, 3 ft. gage; Gen. Man., C. N. Wise.

CARS.—Billmeyer & Small, York, Pa., have an order for 15 passenger cars for the Norfolk & Western. The Haskell & Barker Co., Detroit, Mich., has an order for 750 box cars of 60,000 lbs. capacity, with air brakes and automatic couplers, for the Chicago Great Western. The Elliott Car Co., Gadsden, Ala., is building 500 box cars for the Louisville & Nashville. The Duluth Car Mfg. Co., Duluth, Minn., has an order for 250 ore cars for the Duluth, Mesaba & Northern. The Delaware & Hudson Canal Co. has contracted for 30 passenger cars, 100 coal cars, 500 box cars. Rhodes, Curry & Co., Amherst, N. S., will establish car works. The American Car & Railway Construction Co., Chicago, has been incorporated by Watson Tranter, Wm. A. Conover and J. G. Wolfe, with a capital stock of $1,200,000.

ROAD ROLLER.—A horse road roller of moderate price has been put on the market by the Enterprise Mfg. Co., of Columbiana, O. The roller weighs 4 tons and carries a ballast box on the frame which may be loaded with stone when a 6 or 8-ton roller is desired. The 4-ton roller is less expensive and much easier of transportation than a 6 or 8-ton roller. In using the roller there is an advantage in having the weight adjustable, as the road can be first compacted with the ballast box empty, and it may then be gone over again with the ballast box filled. If the full-weight roller were used at the start, a larger team would be necessary to pull it.

WESTINGHOUSE, CHURCH, KERR & CO., New York, report that the works of the Westinghouse Machine Co. have been running for a year with a full night force, and are crowded with a large amount of heavy work in addition to their regular line of manufacture. There are now in hand ten 600-HP. compound engines, of which eight are for the Philadelphia Traction Co. for direct coupling to multipolar generators, and two are to fill an order placed by E. D. Leavitt for the Calumet and Hecla mines, to be used in driving electric pumps for mine drainage. The company has shipped six 1,000-HP. engines for the Westinghouse Electric Co., to be used for lighting at the World's Columbian Exposition. These engines are also coupled direct to 1,000-light generators. They stand 18 ft. high and make 200 revs. per minute.

THE PENN BRIDGE CO., Beaver Falls, Pa., has the contract for a bridge across the Monongahela River at Elizabeth, Pa.; one span 365 ft., and two spans of 30 ft. each; 18-ft. roadway. Also a contract for a bridge at P St., Washington, D. C., 112-ft. span, 40-ft. roadway.

THE JOHN THOMSON PRESS CO., New York, has been allotted 407 sq. ft. in the Machinery Building at the World's Columbian Exposition, in the platen printing press section, and will make an extensive exhibit of its "Colt's Armory" platen presses, driven by an electric motor.

THE WHEELER CONDENSER & ENGINEERING CO., New York, has moved into new offices at 39 Cortlandt St. The company manufactures condensers, vacuum pans and machinery for sugar, chemical and salt works, and surface condensers for marine and stationary engines. The works are at Carteret, N. J.

NEW COMPANIES.—Milwaukee Railway Incandescent Signal Co., Chicago, Ill.; $250,000; Alexander C. Miller, Thomas A. Banning and S. E. Hibben. Central Construction Co., Chicago, Ill.; to build railways and railway equipment; $50,000; Edwin T. Getchell, Charles H. Morse and Leslie Carter. Minneapolis Paving & Mfg. Co., Minneapolis, Minn.; $50,000; John J. Johnson, Louis Standberg and M. O. Suttgen. Hinson Car Coupler & Mfg. Co., Chicago, Ill.; railway supplies; $2,650,000; Joseph E. Forsyth, E. R. Morrell and James P. Ennis. Cincinnati Paving Block Co., Columbus, O.; $30,000; Geo. J. Atkinson. E. J. Converse and J. M. McDonnell, all of Columbus.

PROPOSALS FOR NEW WATER SUPPLY.

Sealed proposals will be received at the office of the Board of Commissioners of Water-Works of the city of Galveston, Tex., until twelve (12) o'clock, m., of the 8th day of May, 1893, for furnishing the city of Galveston with the material and for performing the work outlined in the following approximate amounts:

About 13,117 tons of 2,000 pounds of 30-inch cast iron water pipe.

About 2,177 tons of 2,000 pounds of 30-inch special cast iron water pipe for submerged pipe line.

About 35 tons of 2,000 pounds of miscellaneous cast iron pipe.

About 60 tons of 2,000 pounds of assorted special casting.

About seventeen 30-inch valves; four 36-inch valves and about forty-six valves of other and smaller sizes.

One stand-pipe, 48 inches in diameter by 40 feet high.

One valve well about 18 feet by 20 feet, and 20 feet deep, with house.

One reservoir, 40 feet inside diameter, with house.

One artesian well system, guaranteed to supply 5,000,000 gallons of water per twenty-four hours.

Laying about sixteen miles of pipe on land.

Laying about two miles of 30-inch submerged pipe.

Erecting one pumping station 40 feet by 80 feet.

Furnishing and erecting on foundations two pumping engines, each of 6,000,000 gallons capacity per twenty-four hours, with boilers.

The work must be completed within twelve months from date of contract. Plans can be seen at the office of the Chief Engineer to the Board of Commissioners of Water-Works.

Printed specifications can be had from the City Clerk or Chief Engineer.

The right is reserved to reject any or all bids.

Bids to be for the whole work and for the different divisions of the work, separately, as per specifications.

Proposals must be made upon blank forms attached to specifications, and accompanied by guarantee bond and the sum of $5,000 in cash on the whole, or a proportionate amount on the different subdivisions of the work, as an evidence of good faith; said amount to be forfeited to the city on failure of bidder to enter contract.

Proposals will be indorsed "Proposal for New Water Supply," and must be addressed to A. S. NEWSON, Chairman of Joint Committee on Water Supply.

A. S. NEWSON,
ROBERT HAYES,
GEO. F. SCHNEIDER, JR.,
J. C. SMITH,
WM. REPPEN,
P. N. HARRIS,
L. SCHMIDT,
JOHN WEGNER,
Joint Committee on Water Supply.

W. KIERSTED, Engineer. 15-4t

GREENVILLE, MISS., WATER-WORKS.

Sealed bids will be received at office of City Clerk of Greenville, Washington County, Mississippi, up to noon on Tuesday, May 2d, 1893, for building city water-works under a franchise system. Bidders to furnish plans and specifications. 14-4t

NOTICE TO PAVING CONTRACTORS.

The Council of the City of Warren, Ohio, by its proper officers will at noon on May 8th, 1893, open bids for the paving of several streets in said city. The approximate amount of the paving will be 19,000 sq. yds. Address E. DICKEY, Engr.

GEORGE P. HUNTER, Ch. St. Com. 16—1t

NOTICE TO DEALERS IN VITRIFIED SALT GLAZED SEWER PIPE, PORTLAND AND AMERICAN CEMENT, AND TO FOUNDRYMEN.

Sealed proposals for furnishing about 200,000 feet of salt glazed vitrified sewer pipe and specials, from four (4) to twenty (20) inches in diameter, about 4,000 barrels of American cement, about 1,000 barrels of Portland cement, and 250 cast iron manhole covers will be received at the office of the City Engineer, City Hall, West Newton, Mass., until Friday, May 5th, 1893, at 12 o'clock, m. The award of the contract, if awarded, will be made by the Joint Standing Committee on Sewers, as soon thereafter as practicable. All proposals must be on a blank form furnished by said committee, and must be accompanied by a certified check upon a National Bank of the cities of Newton or Boston, drawn and made payable to the order of the Treasurer of the City of Newton, for $200. Specifications and forms of contract can be obtained at the office of the City Engineer. The Committee reserves the right to reject any and all bids if they shall deem it to the interests of the City of Newton so to do.

HENRY H. HUNT, Chairman; DARIUS R. EMERSON, HENRY TOLMAN, FREDERIC W. TURNER, EDWARD P. HATCH, the Joint Standing Committee on Sewers.

ALBERT F. NOYES,
City Engineer.

City Hall, West Newton, Mass., April 12, 1893. 15-3t

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica., N. Y. Manufacturers of Lead Pipe and Plumbers' Materials. Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

JOHN W. HARRISON, Pres. and Treas. THOS. HOWARD, Vice-Pres.
F. B. NICHOLS, 2d Vice-Pres. E. H. QUEEN, Sec'y. P. MCARTHUR, Supt.

HOWARD-HARRISON IRON COMPANY,
MANUFACTURERS OF

CAST IRON PIPE

FOR WATER-WORKS, GAS WORKS, CULVERTS.
Pipe and Pump Connections. Flexible Joints. Heavy Loam Castings.
Works at BESSEMER, ALA. Offices at BESSEMER and ST. LOUIS.

ARTHUR KIRK & SON, PITTSBURGH, PA.

POWDER, DYNAMITE, ROCK DRILLS,
AIR COMPRESSORS, ROCK BREAKERS,
Safety Fuse, Electric Batteries, Miners' Squibs.

FOR Best Results USE THE WARREN FILTER,
—MANUFACTURED BY—
CUMBERLAND MFG. CO., Boston, Mass.

THE STANDARD CONSTRUCTION CO.,
GENERAL CONTRACTORS.
SEWER AND MASONRY BUILDING, STREET PAVING, ETC.
Main Office, Lewis Block, Pittsburg, Pa.

Smoothness of motion, absolute safety and high speed are among the good qualities possessed by
OTIS ELEVATORS.
They are built by Otis Brothers & Co., 38 Park Row, New York.

TO CONTRACTORS FOR SEWER CONSTRUCTION.

Office of the Board of Public Works,
Salt Lake City, Utah, April 8, 1893.

Sealed proposals will be received until 2 o'clock p. m. of Wednesday, May 3d, 1893, for the work of constructing a masonry sewer about 40,000 ft. in length, and from 42 to 64 ins. internal diameter. Plans and specifications, showing the character and extent of the work, will be on exhibition at the City Engineer's Office, Room No. 17, City Hall Building, on and after the 17th inst. Full instructions to bidders, with forms for proposal, contract and bond, will be furnished on application, after the 15th inst.

Address Board of Public Works, No. 161 South Main St., Salt Lake City, Utah.

The right is reserved to reject any and all bids.

By order of the Board.
A. F. DOREMUS, C. L. HAINES,
City Engineer. Chairman.
15-3t

World's Fair Route.

The Cincinnati, Hamilton & Dayton R. R. is the only line running Pullman's Perfected Safety Vestibuled Trains, with Chair, Parlor, Sleeping and Dining Car Service, between Cincinnati, Indianapolis and Chicago, and is the Only Line running Through Reclining Chair Cars between Cincinnati, Keokuk and Springfield, Ill. It is the popular line between Cincinnati and St. Louis with Through Sleeping Cars on Night Trains and Chair Cars on Day Trains, and the Only Direct Line between Cincinnati, Dayton, Lima, Toledo, Detroit, the Lake Regions and Canada.

Tickets on sale everywhere, and see that they read C., H. & D., either in or out of Cincinnati, Indianapolis, or Toledo. E. O. McCORMICK, General Passenger and Ticket Agent, Cincinnati, O. 51-20-eow

STREET LIGHTING.

Proposals to light the streets of the Village of Flushing, Queens County, N. Y., will be received by the Board of Trustees of said village at their rooms in the Town Hall until 8 p. m. on the 6th day of June, 1893.

For information and specifications apply to G. A. Roullier, Village Engineer, at No. 20 Main St., Flushing, L. I.

Each bidder will be required to deposit with his proposal or proposals a certified check in the sum of $2,000.

The right is reserved to reject any or all bids.

By order of the Board of Trustees.
CLINTON B. SMITH,
14-3t Clerk.

NOTICE TO PAVING CONTRACTORS.

Notice is hereby given that the Common Council of the City of Muncie, Ind., will at its regular meeting on the 1st day of May, 1893, and thereafter until let to contract, receive sealed proposals for the paving of several streets in said city with Trinidad Lake asphalt.

The amount of said paving will be approximately 20,000 sq. yds. For further information address

W. H. WOOD, City Civil Engineer. 15-2t

TO IRON AND STEEL STRUCTURE CONTRACTORS.

The "Board for the Improvement of Park Ave. Above 106th St." invites proposals for the construction, manufacture, and erection of a "four-track" elevated viaduct structure, to be constructed on Park Ave., between 110th St. and the Harlem River, in the City of New York, in accordance with specifications, copies of which can now be obtained, and the plans of the work seen on application at the office of the Board, Room No. 4, No. 132 Park Ave.

Proposals will be received at the office of the Board until the hour of 3 o'clock p. m., on Thursday, the 4th day of May, 1893, at which place and hour they will be publicly opened by the President of the Board.

Blank proposal forms and envelopes for inclosure of same, and any further information desired can now be obtained on application at the above-named office.

By order of the Board:
CHARLES W. DAYTON, President.
New York, March 30.

COMMONWEALTH OF MASSACHUSETTS METROPOLITAN SEWERAGE COMMISSIONERS—NOTICE TO BUILDERS OF PUMPING ENGINES.

Sealed bids for the pumping plant for the Metropolitan Sewerage pumping station at East Boston, and sealed bids for the pumping plant for the Metropolitan sewerage station at Deer Island, will be received by the Board of Metropolitan Sewerage Commissioners at its office, 110 Boylston Street, Boston, Mass., until 12 o'clock m. of Saturday, May 27, 1893, and at that time will be publicly opened and read.

The Board will provide at each pumping station, an engine house, boiler house, chimney and masonry foundations for the pumps, and will furnish a fresh-water supply for the boilers up to the interior of the boiler house. The contractor's bid for each plant must be for furnishing, setting up, and completing, ready for use, two pumping engines (or sets of engines), four boilers, piping and all necessary appliances and fittings such as are to be found in pumping stations of the best class.

Each pumping engine must be capable of easily raising 70 cubic feet of sewage per second 19 feet vertically above the level of the sewage in its respective pump-well. Each of the engines must also be capable of raising to greater lifts up to 25 ft. quantities of sewage inversely proportional to such lifts.

Each engine must also be capable of pumping at as low a rate as 15 cubic feet per second, and at all rates between 15 and 70 cubic feet per second.

The foregoing capacities must be demonstrated by suitable trials.

Each bidder must state in his bid the duty he will guarantee for each engine in the duty trials outlined in the general specifications:

Table of Some Approximate Working and Trial Data, Etc.

	Deer Isl.	East Boston.
Elevation of the surface of the sewage in the pump-well above datum....(Varies from	and. Feet. 94.0	Feet. 90.8
(to	101.4	93.5
Elevation of the bottom of the pump-well is assumed to be..	85.5	80.0
Elevation of the surface of the sewage in the discharge channel above datum.(Varies from	101.0	105.3
(to	120.0	112.5
Least lift.....	6.0	14.5
Average lift.....	11.0	15.0
Ordinary maximum lift.....	18.6	19.0
Lift during duty trial at rate of 70 cu. ft. per sec.....	11.0	15.0
Lift during capacity trial at rate of 70 cu. ft. per sec...	19.0	19.0
The elevation of the boiler house floor should be not lower than.....	116.5	116.5

The elevations mentioned above are referred to a datum about 100.64 feet below mean low water of Boston Harbor.

The contractors must provide at each station four steam boilers of such capacity that any three of them can easily supply the necessary steam for the two engines when discharging together 140 cubic feet per second with a lift of 19 feet.

Plans will be furnished by the Board showing the position of the engine houses and the in-coming and out-going sewers at East Boston and Deer Island.

The first pumping engine at each station, and at least two boilers at each station, must be set up, ready to run, before May 31, 1894; the remaining engine, boilers and other appliances before Aug. 31, 1894. A third pumping engine and additional boilers will probably be called for at each station within a few months thereafter, and a fourth engine and additional boilers may be needed in the future. The third and fourth engines and their boilers are not now to be bid for. The arrangement of the plant, however, must be such as will not interfere with the above named extension.

The design of the pumping engines may be of any form which will fulfill the required conditions.

Each bid must be accompanied by drawings showing clearly the size and arrangement of the steam cylinders, pumps, boilers and all other parts of the mechanism and must also show the necessary details for the engine foundations, which are to be provided by the Board.

The specifications, which must also accompany the bid, must give the kind and the quality of the materials of which the various parts are to be composed, the size and the strength of the principal working parts, and the manner in which they are to be constructed, so as to furnish a clear understanding of all points regarding the workmanship, strength, durability, general efficiency of and space occupied by the whole mechanism and plant.

Each bid must be inclosed in a sealed envelope indorsed "Proposal for Pumping Plant for the Metropolitan Sewerage Pumping Station at East Boston" or "Proposal for the Pumping Plant for the Metropolitan Sewerage Pumping Station at Deer Island," and be delivered to the Board or to its clerk.

Each bid must be made on one of the blank forms furnished by the Board, and must be accompanied by a properly certified check for the sum of $1,000, the latter to be returned unless forfeited by the abandoning of the proposal.

The Board reserves the right to reject any and all bids.

Plans, blank forms, general specifications and further information may be obtained at this office.

HOSEA KINGMAN,
TILLY HAYNES,
HARVEY N. COLLISON,
Board of Metropolitan Sewerage Commissioners of Massachusetts.

HOWARD A. CARSON,
Chief Engineer. 12-3t

TO MASONRY CONTRACTORS.

Sealed proposals for the construction of a receiving reservoir, and foundations for a pumping station and chimney will be received by the Sewerage Commissioners of the City of Brockton, Mass., until 12 o'clock noon on May 1st, 1893, at their office, Home Bank Block, Brockton, Mass.

The Engineer's estimate of work to be done is as follows:

400 cubic yards of loam placed in spoil banks.

400 cubic yards of loam taken from spoil banks and placed.

7,200 cubic yards of earth excavation.

1,700 cubic yards of rubble masonry.

225 cubic yards of brick masonry.

600 cubic yards of concrete.

Each proposal must be made upon the blank forms furnished by the Commissioners, and must be accompanied by a certified check for the amount of $400.

Forms of contract and specifications can be obtained at the above office.

The Commissioners reserve the right to reject any and all bids.

R. P. KINGMAN,
H. A. MONK,
A. C. THOMPSON,
Sewerage Commissioners.

F. HERBERT SNOW,
City Engineer. 15-2t

NOTICE TO SEWER CONTRACTORS.

Sealed proposals indorsed "Proposals for Building Section 6 of the Newton Sewer System" will be received at the office of the City Engineer, City Hall, West Newton, Mass., until Friday, May 5th, 1893, at 12 o'clock m. The award of the contract, if awarded, will be made by the Joint Standing Committee on Sewers, as soon thereafter as practicable. All proposals must be on the blank furnished by said Committee, and must be accompanied by a certified check upon a national bank of the Cities of Newton or Boston, drawn and made payable to the order of the Treasurer of the City of Newton, for $500.

Some of the approximate quantities for the section are as follows: 17,500 feet of pipe sewer from 6 inches to 15 inches; 300 cubic yards brick masonry; 20,300 cubic yards of material to be excavated at various depths.

Plans can be seen, and specifications and form of contract can be obtained at the office of the City Engineer.

Each bidder is required to make a statement indicating what sewer work he has done, and to give references that will enable the Committee to judge of his business standing, and no bid will be received in case the bidder has not looked the work over on the ground.

The Committee reserve the right to reject any and all bids if they shall deem it for the interests of the City of Newton so to do.

HENRY H. HUNT, Chairman; DARIUS R. EMERSON, HENRY TOLMAN, FREDERIC W. TURNER, EDWARD P. HATCH, the Joint Standing Committee on Sewers.

ALBERT F. NOYES,
City Engineer.

City Hall, West Newton, Mass., April 12, 1893. 15-3t

TO CONTRACTORS FOR PIPE SEWERS.

Sealed proposals for laying about 11 miles of pipe sewers, and constructing the necessary manholes and other appurtenances required for the sewerage system of the City of Rochester, N. H., will be received by the City Clerk until Wednesday noon, May 3d, 1893. The bidder will be required to deposit a certified check in the sum of eight hundred (800) dollars, made payable to the order of the Treasurer of the City of Rochester, to be forfeited provided contract is not executed within five days after notification of the acceptance of proposal. Plans, profiles, and specifications can be seen on application to the Committee on Sewerage, Rochester, N. H., or, at 205 Congress St., Boston.

CHARLES S. BARKER,
J. THORNE DODGE,
CHARLES W. HOWE,
Committee on Sewerage.

J. F. SPRINGFIELD,
City Engineer. 16-2t

TO GRADING CONTRACTORS.

110,000 cubic yards of earth grading to be let at once. Work at Dolgeville, N. Y. Profiles and specifications can be seen at office of Alfred Dolge, 122 East Thirteenth St., New York, or at the Land Department, Dolgeville, N. Y., on and after Monday, April 24th, 1893.

REPAIRING MACADAMIZED ROADWAY.

Proposals, including the furnishing of material necessary to repair about two miles of the macadamized highway known as the Jericho Turnpike, situated partly in the First and partly in the Second Divisions of Queens County, N. Y., will be received by the Board of Supervisors of said County at the "Asylum," Mineola, until 12 o'clock noon, on the 9th day of May, 1893.

For information and specifications apply to the Division Engineers, as follows: For First Division, G. A. Roullier, 20 Main St., Flushing, L. I.; for Second Division, John J. McLaughlin, Fulton St., Jamaica, L. I.

A certified check in the sum of $500 shall accompany each proposal.

The right is reserved to reject any or all proposals.

By order of the Board of Supervisors, Queens County, N. Y.

16-2t ROBERT SEABURY, Clerk.

TO BRICK PAVING CONTRACTORS.

The Board of Public Works and Affairs of Nashville, Tenn., will be prepared to receive bids until 3 o'clock p. m., May 4th, 1893, for paving Spruce Street with brick, between Broad Street and Lee Avenue. Approximate quantity, 6,500 yards. By order of the said Board. Right reserved to reject any or all bids. J. A. JOWETT,
16-2t City Engineer.

NOTICE TO SEWER CONTRACTORS.

Sealed proposals will be received at the Post Office, Oradell, N. J., until Monday, May 1st next, at 7 p. m., for the construction of approximately 2,500 lineal feet of 8-in. sewer, together with an outlet and the necessary manholes, flush-tanks, etc. Plans and specifications can be seen at the store of Van Buskirk & Landman, Oradell, N. J., or at the office of Wise & Watson, Civil Engineers, Passaic, N. J.

The Committee reserves the right to reject any and all bids.

A. LANDMAN,
16-2t Chm. of Committee.

TO SEWER CONTRACTORS.

The Board of Public Works and Affairs of Nashville, Tenn., will be prepared to receive bids until 3 o'clock p. m., Tuesday, May 16th, 1893, for constructing sections A, B, C, D and E of the Lick Branch Sewer, and all necessary connections and incidental work.

Contractors may bid on any or all sections; but if more than one section is bid on, the bids must be separate.

The said Board reserves the right to reject any or all bids, and to award the contract as a whole, or in such portions as the interest of the city requires or to award any contract for any section, and to reject all other bids.

All bids must be accompanied by a certified check, payable to the order of the Board of Public Works and Affairs, in the sum of $1,000 for each section of said work bid upon. This check (or checks) to be forfeited by any bidder to whom any bid is awarded and who shall thereafter refuse to enter into a contract to do the work so awarded.

Specifications and drawings can be examined at the City Engineer's office.

Bidders are informed that, according to the act of the Legislature of 1893, no bidder shall employ convict labor in the said work or any part of it.

By order of the Board of Public Works and Affairs. J. A. JOWETT,
16-4t City Engineer.

TO DEALERS IN CEMENT.

Sealed proposals for the delivery of about 1,000 barrels of Portland cement, and of about 4,500 barrels of American cement, will be received by the Sewerage Commissioners of the City of Brockton, Mass., until 12 o'clock, noon, on May 1st, 1893, at their office, Home Bank Block, Brockton, Mass.

Each proposal must be made upon the blank forms furnished by the Commissioners, and must be accompanied by a certified check for the amount of $200.

Forms of contract and specifications can be had at the above office.

The Commissioners reserve the right to reject any and all bids.

R. P. KINGMAN,
H. A. MONK,
A. C. THOMPSON,
Sewerage Commissioners.

F. HERBERT SNOW.
City Engineer. 16-1t

COLORADO STATE CAPITOL.

Sealed proposals will be received by the Secretary of the Board of Capitol Managers until 12 o'clock, noon, mountain time, on May 20, 1893, for all material and labor required to complete the following work:

Class I.—Steam heating and ventilating.

Class II.—Plumbing.

Class III.—Electric wiring.

Class IV.—Gasfitting.

Class V.—Wood furring.

Drawings, specifications and details can be seen after April 25, 1893, in the office of the Superintendent, Peter Gumry, at the Capitol Building, Denver, Colorado.

Proposals may be submitted for the entire work, or for each class separately, the Board of Capitol Managers reserving the right to accept such proposals as they may deem for the best interest of the state, or to reject any and all propositions.

Proposals must be submitted on blanks furnished upon application to the Superintendent, and no bid will be considered unless submitted on said blanks.

All bidders will be required to furnish a certified check, payable to the order of the Board of Capitol Managers, equal in amount to two and one-half (2½) per cent. of the bids submitted, which amount will be forfeited to the Board in the event of the failure or refusal of any successful bidder to enter into contract with sufficient sureties.

All bids must be sealed and indorsed "Proposal for State Capitol Building. Class No. ——," and addressed to the Secretary of the Board of Capitol Managers, P. O. Box 1242, Denver, Colorado.

By order of the Board:

HERMAN LUEDERS,
Denver, April 12, 1893. Secretary.
16-2t

BRICK PAVING.

Sealed proposals will be received up to 8 p. m., city time, on May 2d, 1893, by the City Council of Albion, Mich., for the grading, curbing and paving with vitrified brick, of Superior Street, from Ash Street to the Lake Shore & Michigan Southern R. R. Bidders will be required to state prices on two kinds of foundation, viz., concrete and plank, and deposit a certified check of not less than 5 per cent. of the amount of the proposal. The approximate quantities are: Length, 1,950 yards. Curbing, 4,035 feet. Paving, 15,000 square yards.

Estimates are also asked upon the following plans over same street and distances: Cost of grading, curbing and paving 18 feet of gutter, both sides of street with cobble stone, and 32 feet in center with vitrified brick; also same, grading, curbing and paving 18 feet of gutter alone with cobble stone; also same, grading, curbing and paving 18 feet of gutter with vitrified brick alone. The right is reserved to reject any and all bids. Plans and specifications, and further information may be obtained from the undersigned. P. M. DEARING,
City Clerk.

Albion, Mich., April 10th, 1893. 16-2t

U. S. ENGINEER OFFICE, ROOM H7, Army Building, 39 Whitehall Street, New York City, April 12th, 1893.—Sealed proposals for construction of dike in Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock, noon, on Friday, May 12th, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. D. C. HOUSTON, Colonel, Corps of Engineers. 15-4t

U. S. ENGINEER OFFICE, WILMINGTON, Del., April 11, 1893.—Sealed proposals for dredging in Cambridge Harbor, Md., will be received at this office until 12 o'clock noon, May 11, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. WM. F. SMITH, United States Agent. 15-4t

U. S. ENGINEER OFFICE, ROOM H7, Army Building, 39 Whitehall Street, New York City, April 12th, 1893.—Sealed proposals for hire of dredging plant for improving Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock, noon, on Friday, May 12th, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. D. C. HOUSTON, Colonel, Corps of Engineers. 15-4t

UNITED STATES ENGINEER OFFICE, Wilmington, Del., April 18th, 1893.—Sealed proposals for dredging and excavating for the construction of an inland waterway from Chincoteague Bay, Va., to Delaware Bay, Del., will be received at this office until 12 o'clock noon, May 18th, 1893, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. WM. F. SMITH, United States Agent. 16-4t

OFFICE OF LIGHTHOUSE ENGINEER, Fifth District, Baltimore, Md., April 7, 1893.—Sealed proposals will be received at this office until 2 o'clock p. m. of Wednesday, the 17th day of May, 1893, for furnishing the materials and labor of all kinds necessary for the completion, delivery and erection at the sites of the metal work of Cape Charles and Hog Island Light Towers, Virginia, for a fixed sum for each light tower, or for an aggregate sum for both towers. The bids most advantageous to the United States Government will be accepted. Plans, specifications, forms of proposal and other information may be obtained on application to this office. The right is reserved to reject any or all bids and to waive any defects. ERIC BERGLAND, Captain of Engineers U. S. A., Lighthouse Engineer, Fifth District. 15-3t

U. S. ENGINEER OFFICE, CHARLESTON, S. C., April 15, 1893.—Notice is hereby given to all parties interested in the wreck of the schooner "Kate V. Aitken," in Swash Channel, Charleston Harbor, S. C., or in the cargo, if any, of said craft, that if same are not removed within 30 days it is the purpose of the Hon. the Secretary of War of the United States to treat said wreck and cargo as abandoned and derelict, and cause their removal, as prescribed by Sec. 4, Act of Congress, approved June 14, 1880. Sealed proposals for removing this wreck will be received at this office until 12 noon of May 15, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. 16-4t

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APPENDICES:

A. Electric Railway vs. Telephone Decisions. B. Instructions to Lineman. C. Engineer's Log Book. D. Classification of Expenditures of Electric Street Railways. E. Concerning Lightning Protection, by Prof. Elihu Thomson. F. Motors with Beveled Gear, and Series Multiple Control of Motors. G. Method of Measuring Insulation Resistance of Overhead Lines.

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